MANUAL OF DESIGN CRITERIA AND STANDARD SPECIFICAITON FOR THE CONSTRUCTION OF PUBLIC IMPROVEMENTS
September 8, 2002 (Ordinance 733)
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SECTION 1
PUBLIC IMPROVEMENT PROCEDURES AND POLICIES

1.1 GENERAL

1.1.1 THE PURPOSE OF THIS SECTION IS TO:

1. Outline the procedures for the processing of public improvement plans required for the development of properties within the Town limit; and
2. Provide a statement of policies governing the extension of public improvements to serve new developments or subdivisions and the oversizing of public improvements beyond the capacity requir4d to serve the needs of the new development or subdivision.

1.1.2 DEFINITION OF PUBLIC IMPROVEMENTS: For the purpose of this manual public improvements are defined as those capital investments made to serve subdivisions with streets, curb and gutters, sidewalks, storm drainage facilities, street name signs, traffic control devices such as signs, signals and lane striping water distribution system, wastewater collection system, electrical distribution system and street lighting.

1.1.3 PREPARATION OF PUBLIC IMPROVEMENT PLANS AND REPORTS: The public improvement plans and the corresponding reports in support thereof shall bear the seal of a professional engineer registered in the State of Colorado certifying to the accuracy and completeness of the information contained in the plans and reports , and assuming full responsibility thereof.

1.2 PROCEDURES FOR PROCESSING PUBLIC IMPROVEMENT PLANS

The submittal, review and approval of public improvement plans shall coincide and be a part of the subdivision platting process as described in the Subdivision Regulations, Title 10 of the Lyons Municipal Code as follows:

1. Sketch Plan Phase: Public improvement inputs in this phase required only a listing of anticipated supplies of utilities (water, sewer, gas, electric, phone) and natural and man-made characteristics of the site that would affect public improvements such as flood plain, storm drainage, slope of the land and proposed connections to existing public improvement systems.
2. Preliminary Plan Phase: Public improvements at this stage of the subdivision process must be sufficiently planned to allow for the determination of location and size or capacity for each public improvement to include:
    a. Street Locations and planned cross-sections for right of way and street widths.
    b. Utility system layout and line sizes for water distribution, sewer collection and electric distribution.
    c. Storm drainage plan and report describing the existing flow patterns and historical runoff and how the developer proposes to mitigate potential drainage, erosion and storage problems which could result from the development.
3. Final Plat Phase: Public improvement plans are to be filed with the final plat and shall include the details necessary for the subdivision. Reports providing the design data and calculations as required in the following sections of this manual must also be submitted with the final plat.

Upon final approval of the public improvement plans a complete set of mylar reproducibles will be furnished to the Town for approval signatures. The mylar reproducibles will be retained by the Town. No changes from the approved public improvement plan will be permitted during the construction of the public improvements unless such changes are approved by the Town and the final public improvement plans revised to reflect the changes.

1.2.1 PUBLIC IMPROVEMENT PLANS: The Public Improvement plans shall be organized as follows:

1. Title Sheet:
   a. Name of Subdivision
   b. Vicinity map
   c. Name, address, and seal of engineer
   d. Approval block for Town Administrator
   e. Index for each sheet contained in the plan

2. Storm Drainage Sheet:
   a. Existing and proposed contours.
   b. Finish grade for all lots and streets
   c. Existing and proposed storm drainage facilities.

3. Street and Utility Layout Sheet: Plan view for all street and utility lines indicating points of connection to existing facilities to include:
   a. Streets
      1. Right of way width
      2. Curb to curb width
      3. Sidewalk locations
      4. Type and location of traffic control devices
   b. Water
      1. Valve locations
      2. Fire hydrant locations
      3. Line sizes
      4. Pumping station location, if applicable
   c. Sewer
      1. Manhole locations
      2. Line sizes and direction of flow
      3. Lift station location, if applicable
   d. Electric
      1. Transformer locations and sizes
      2. Primary and secondary conductor sizes
      3. Type and location of street lighting

4. Street Plan-Profile-Sheet: Plan and profile for each street segment with existing ground and finish street profiles shown. Both curb profiles are required when at different elevations.

5. Sewer Plan-Profile Sheet: Plan and profile for each sewer line segment with existing ground and finish street profiles shown. Manholes and water lie crossings are to be shown on profile.

6. Detail Sheet: Cross sections and details for streets, curb/gutter, sidewalk, gutter pan, catch basins, fire hydrants, manholes, pumping stations, lift stations, transformer pads, handicapped curb ramps and other details as required. These details and cross sections may be shown on layout and plan profile sheets rather than separate detail sheet.

1.2.2 DESIGN AND CONSTRUCTION OF PUBLIC IMPROVEMENTS: The development of the public improvement plans will be guided by the design criteria contained in this manual for each of the public improvements. Deviations from these design criteria, specifications, and the construction methods require the approval of the Town Administrator.

The Plans and specifications used by the developer for the construction of all public improvements must conform with the public improvement plans approved by the Town and the specifications and construction methods contained in this manual. These specifications and construction methods serve to establish minimum standards acceptable by the Town of all materials, equipment and construction methods employed in the construction of the public improvements.

All tests identified in this manual for the construction of public improvements shall be performed by the Contractor or an independent testing laboratory as required at the expense of the Developer.

1.3 PUBLIC IMPRVEMENT EXTENSION POLICIES

1.3.1 PUBLIC IMPRVEMENTS INTERNAL TO SUBDIVISON: The planning, design and construction of all public improvements required for a subdivision will be provided by the developer. The design criteria and construction specifications and details for the public improvements are contained in this manual.

1.3.2 PUBLIC IMPROVEMENTS ON PERIMETER OF SUBDIVISON: Street and utility lines located along the subdivision perimeter will be considered as follows:

1. Those public improvements that serve only the subdivision being developed in which case they will be treated as public improvements internal to the subdivision.
2. Those public improvements that will benefit adjacent future subdivision as well as the subdivision being developed in which case the following may apply:
   a. Streets: The developer will plan and design the full street width and construct only the half street width consisting of sidewalk, curb/gutter and a minimum street width from curb face to end of street construction of 21 feet.
   b. Utility Lines: the additional construction cost resulting from the installation of utility lines with capacity exceeding that required for the subdivision will be considered as an oversized public improvement.

1.3.3 PUBLIC IMPROVEMENTS EXTERNAL TO THE SUBDIVISION: Streets and utility lines located external to the subdivision will be considered as follows:

1. Those undersized public improvements that pass through developed areas required to serve the proposed subdivision in which case the developer will bear the cost to upgrade the public improvement to accommodate the subdivision while the Town may participate in the cost to oversize the public improvement beyond that required by the subdivision.
2. The extension of public improvements through undeveloped areas to serve the subdivisions in which case the developer will bear the full cost to construct the public improvements including acquisition of right of way and easements. The Town will require the developer to size the public improvements to accommodate not only the developer's subdivision but also the undeveloped area

through which the public improvements pass. To permit the developer to recover the investment the Town may enter into an agreement with the developer specifying that as the area develops provisions will be made to require reimbursement for those improvements that benefit new developments or subdivision.

1.4 PUBLIC IMPROVEMENT OVERSIZING POLICIES

The Town may participate in oversizing of public improvements by sharing the cost of construction of public improvements with capacity greater than that which is required to satisfy the subdivision needs. Under the extension policy the developer is required to provide all public improvements necessary to support the subdivision. The Town may require that certain of the public improvements be oversized to satisfy future growth or other Town needs. The cost for this oversizing may be paid for by the Town as follows:

1. Streets: The full costs for all local and collector streets will be paid for by the developer. Arterial streets, unless required to support the traffic volume generated by the subdivision, will be considered oversized streets. For arterial streets, identified as oversized streets by the Town, the developer will provide for oversized sidewalk, curb/gutter and a forty-two (42') width of street measured from curb face to curb face. The Town's share will be for all street construction exceeding the forty-two foot (42"0 width.
2. Water Distribution System: All lines over six inch (6"0 diameter and sized greater than required to meet subdivision needs and required by the Town will be considered oversized water lines. (Except for those covered under 1.3.3 par 2). The additional construction costs due to the oversizing may be provided by the Town. The oversizing cost will be determined by a method to be specified by the Town.
3. Sewer Collection System: All liens over eight inch (8") diameter and sized greater than required to meet subdivision needs and required by the Town will be considered oversized sewer lines. (Except for those covered under 1.3.3 par 2). The additional construction cost due to the oversizing may be provided by the Town. Since no change in the number or size of manholes will result with the oversizing they will not be considered in determining the oversizing costs. The oversizing costs will be determined by a method to be specified by the Town.
4. Electric Distribution System. All primary conductor over 1/0 and sized greater than required to meet subdivision needs and required by the Town will be considered oversized electric lines. (Except for those covered under 1.3.3 par 2). The additional construction costs due to the oversizing may be provided by the Town; Since no change in the number and size of transformers and in the secondary system will result with the oversizing they will not be considered in determining the oversizing costs. The oversizing costs will be determined by a method to be specified by the Town.
5. Other oversized facilities directed by the Town, such as pumping stations, lift stations and storm drainage systems may also be acceptable as oversized public improvements for Town participation. The oversizing costs in each case will be determined by a method to be specified by the Town.

1.5 EXCEPTIONS TO THE PUBLIC IMPROVEMENT EXTENSION AND OVERSIZING POLICIES

All exceptions to the public improvement extension and oversizing policies as stated in this section require the approval of the Town Board. The Town Board will act upon a recommendation form the Town Board will act upon a recommendation from the Town Planning Commission on the requested exception.

1.6 PHASED CONSTRUCTION OF PUBLIC IMPROVEMENTS

A developer may phase the construction of public improvements in an approved subdivision, subject to the following conditions:

1. The minimum size of the phased development for the subdivision must correspond to a cul-de-sac or a local street providing access to a minimum of ten lots.
2. Access is available to the phased area with paved street and sidewalk.
3. Reliable utility service is available as determined by the Town.
4. Potential storm drainage problems are resolved to the satisfaction of the Town.
5. Temporary turn around area is provided if the street through the phased area is temporarily dead-ended.

1.7 FUNDS FOR OVERSIZING COSTS

The source of funds to pay for Town participation in oversizing costs are as follows:

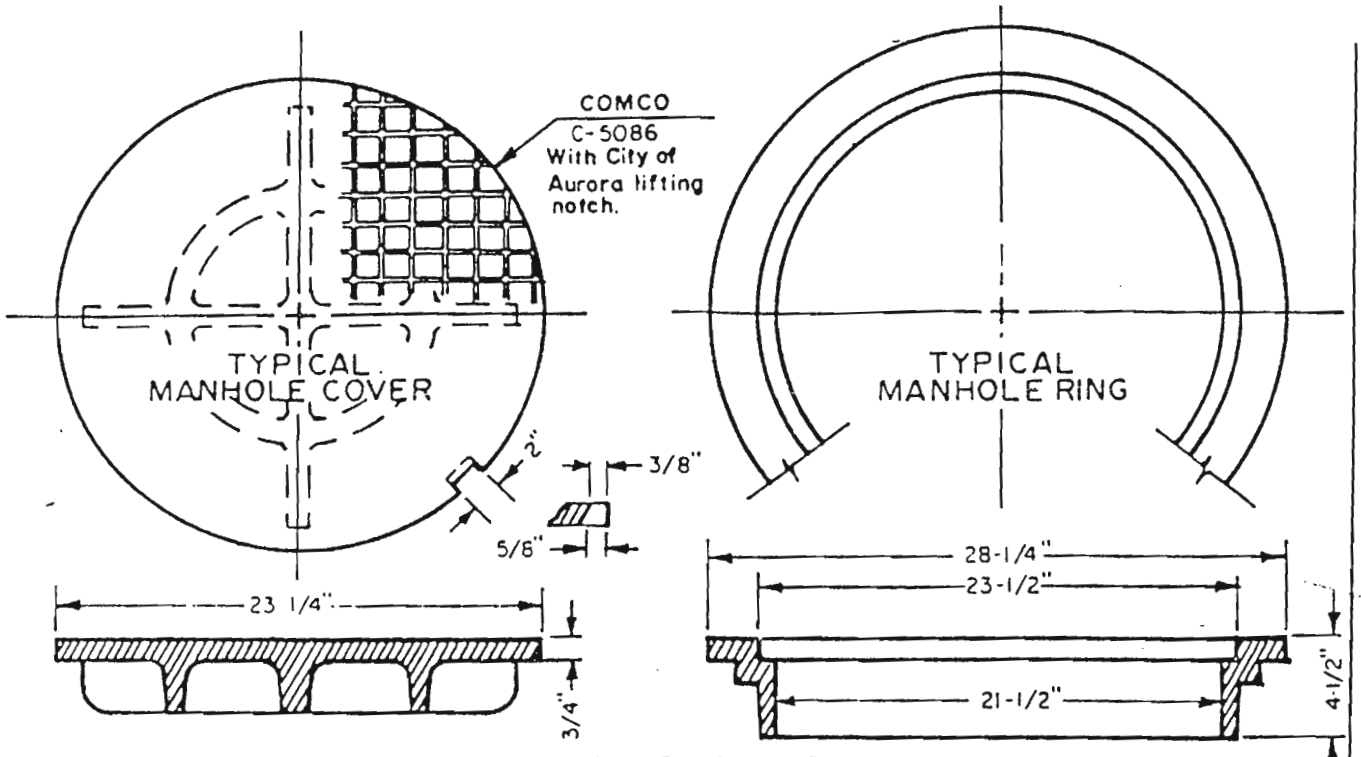
1. Streets; General Fund
2. Water and Sewer: Tap fees
3. Electric: Service charge
4. Storm Drainage: general fund

1.8 ISSUANCE OF BUILDING PERMITS AND CERTIFICATES OF OCCUPANCY

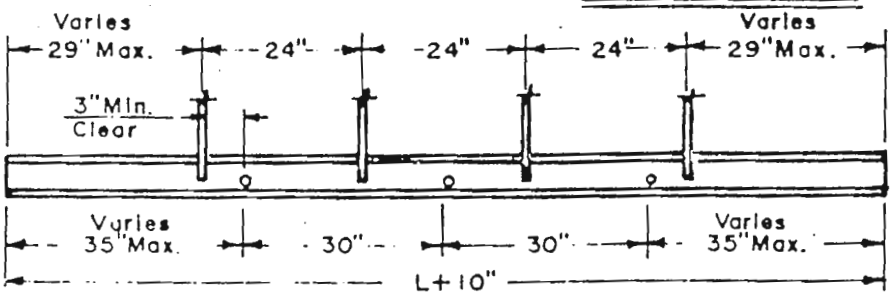
1.8.1 PERMITS: No building permits will be issued by the Town for any lot within the Town limits until:

1. All final plat requirements (including public improvement plans) have been completed and approved by the Town.
2. The construction of the public improvements have progressed to at least fifty percent of completion for the subdivisions or phased area of a subdivision as described in 1.6.

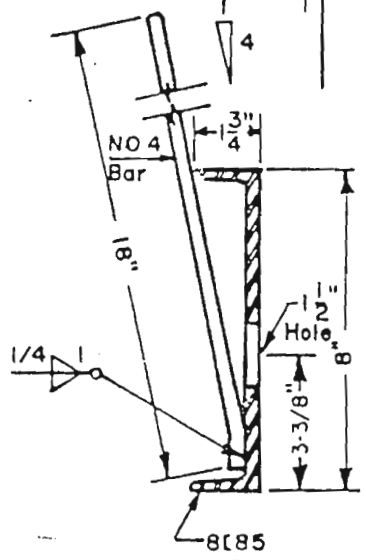
1.8.2 CERTIFICATES OF OCCUPANCY: No certificates of occupancy will be issued by the Town until all the public improvements are completed for the subdivision or phased area of a subdivision as described in 1.6.



NOT TO SCALE



CHANNEL LAYOUT DETAILS



TYPICAL SECTION
AT HOLE

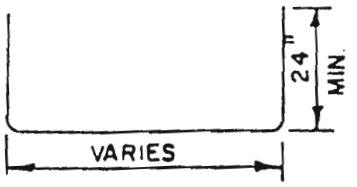
GENERAL NOTES

1. All work shall be done in accordance with acceptable construction practices
2. All concrete shall be class I.- Type II
3. Concrete walls shall be formed on both sides and shall be 8" thick.
4. Curb face assembly shall be galvanized after welding in accordance with A.A.S.H.T.O. M 111.
5. Exposed concrete corners shall be beveled to a 1-1/2" face. Curb & Gutter corners shall be finished to match the existing curb & gutter beyond the transitional gutter.
6. Reinforcing bars shall be deformed and shall be new billet steel, grade 40 and conform to A.A.S.H.T.O. M 30.
7. No splices permitted in top slab, 12" (No. 4 Rebar) & 14" (No 5 Rebar) lap splices in accordance with A.C.I 318 are permitted in all other sections.
8. All bars shall be a minimum of 2" Clear
9. Since pipe entries into the inlet are variable, the dimensions shown are typical. Actual dimensions and quantities for concrete and reinforcement shall be as required in the work.
10. Contractor shall be responsible for bar list.
11. All work shall be done in accordance with ACI 318.
12. Dimensions and weights of Typical Manhole Ring & Cover are nominal.

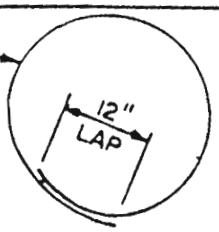
FIGURE 2-2a

COLORADO DEPT OF HWYS

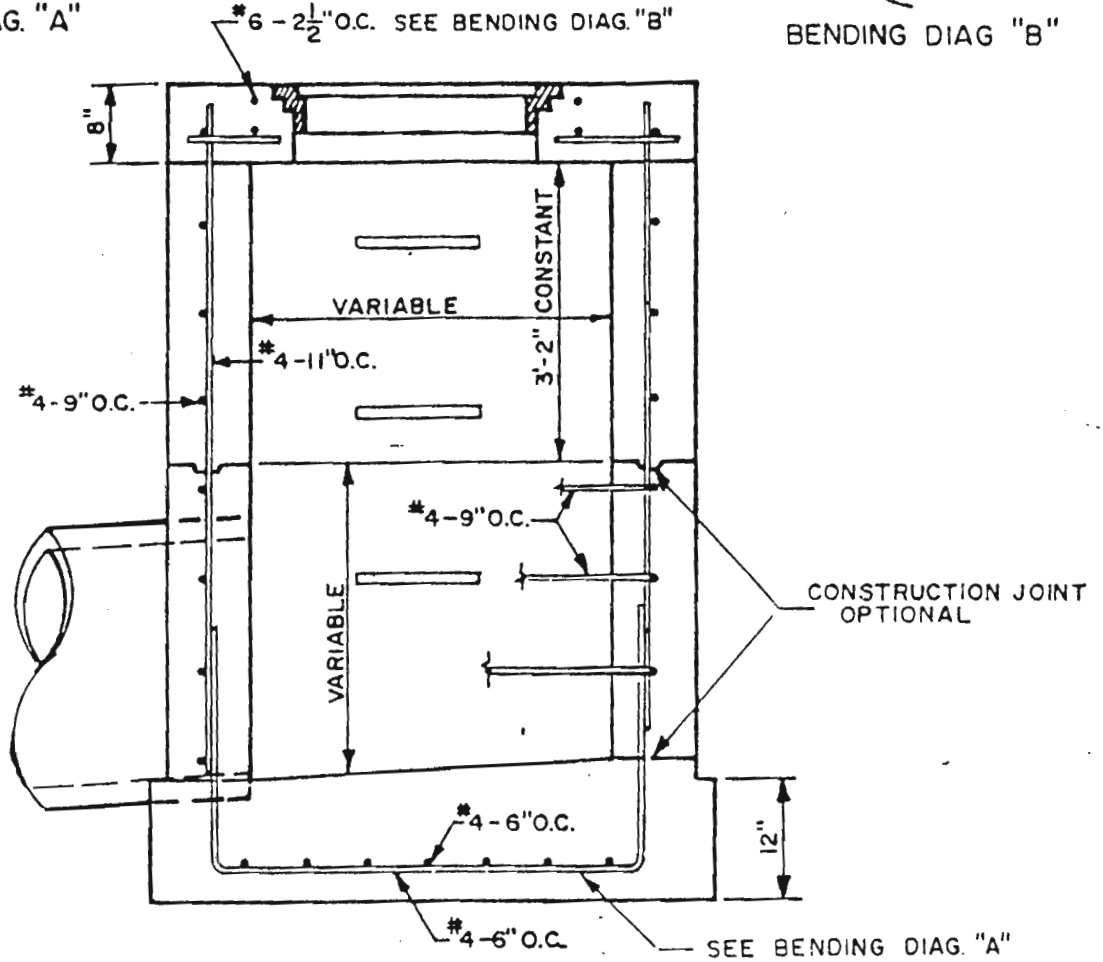
— TYPE "R" INLET



BENDING DIAG. "A"



BENDING DIAG "B"



SECTION A-A
REGULAR INLET
NOT TO SCALE

NOTE:
ALL CONSTRUCTION JOINTS SHALL HAVE A 2"X4" KEYWAY.

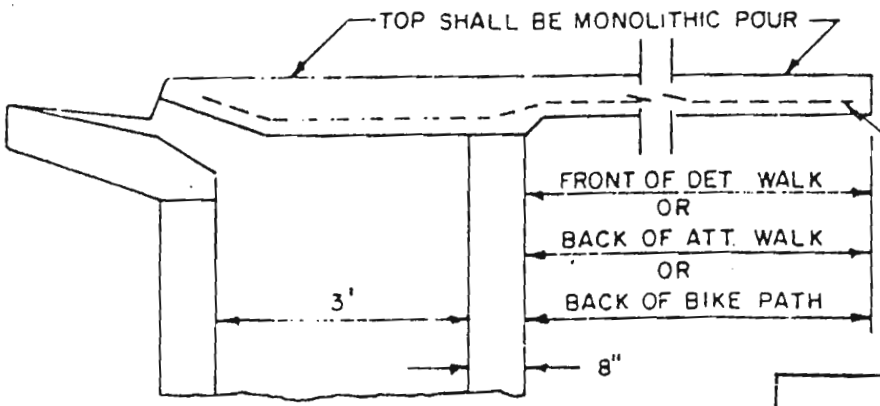


FIGURE 2-2b

COLORADO DEPT OF HWYS
TYPE "R" INLET

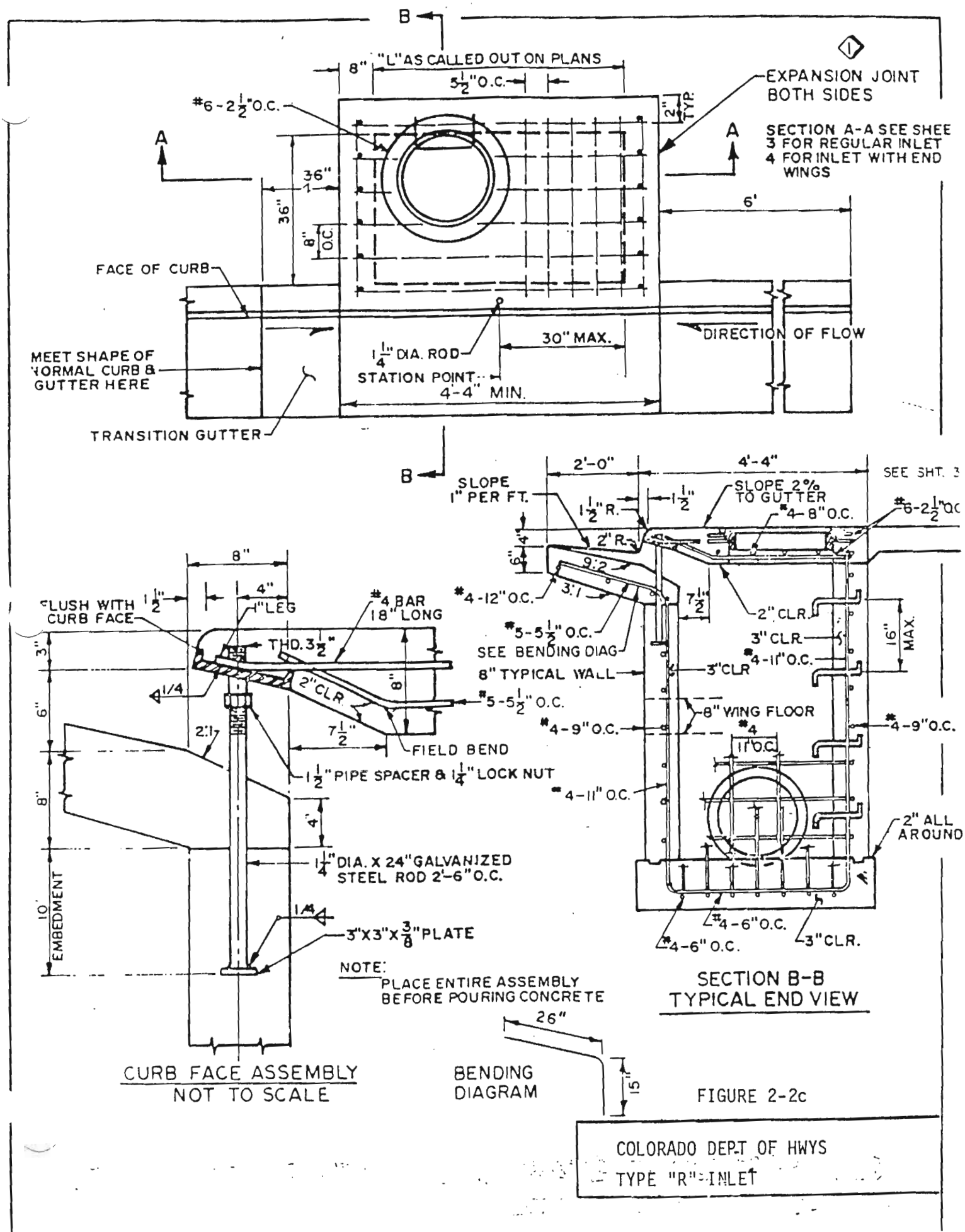
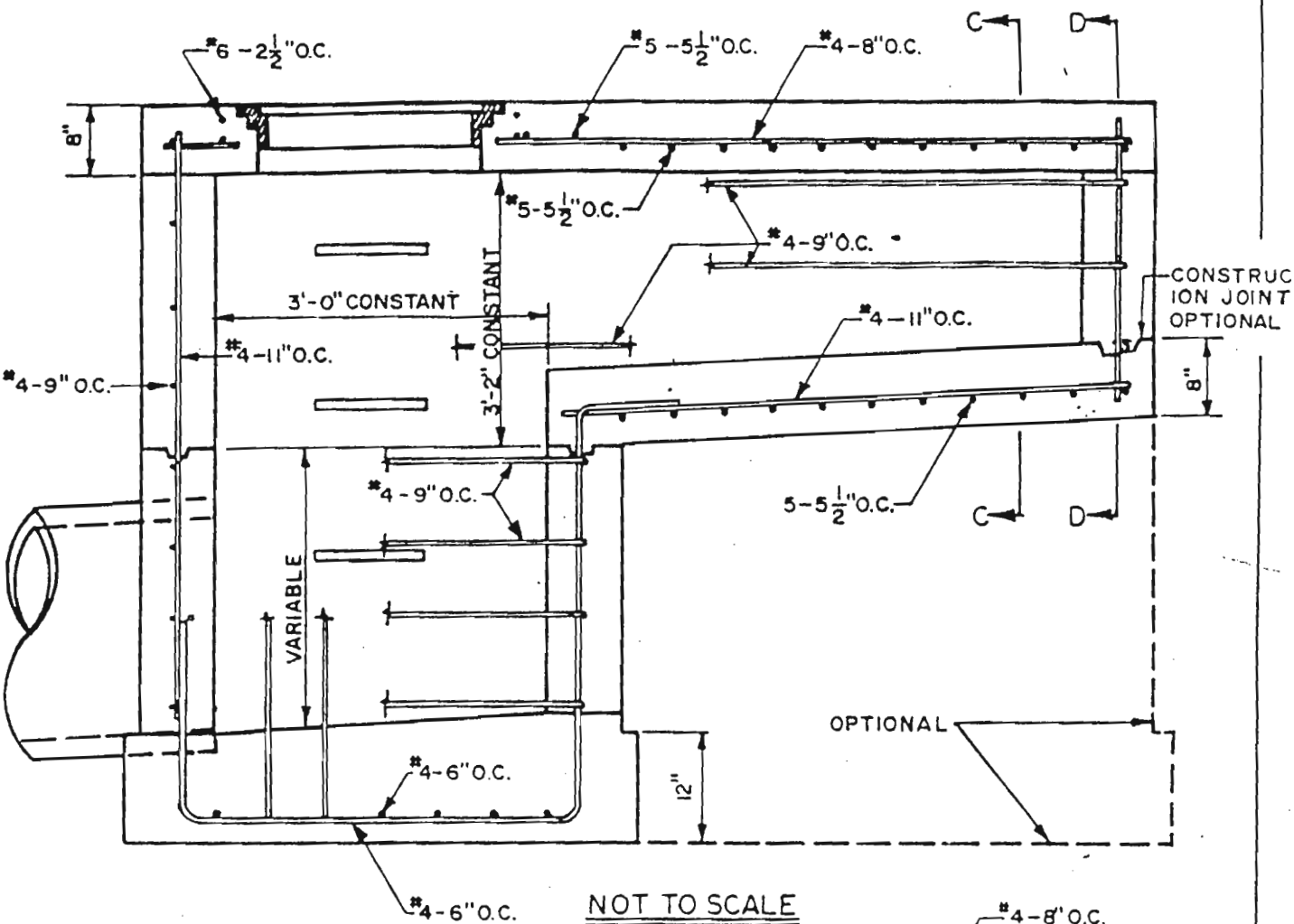


FIGURE 2-2c

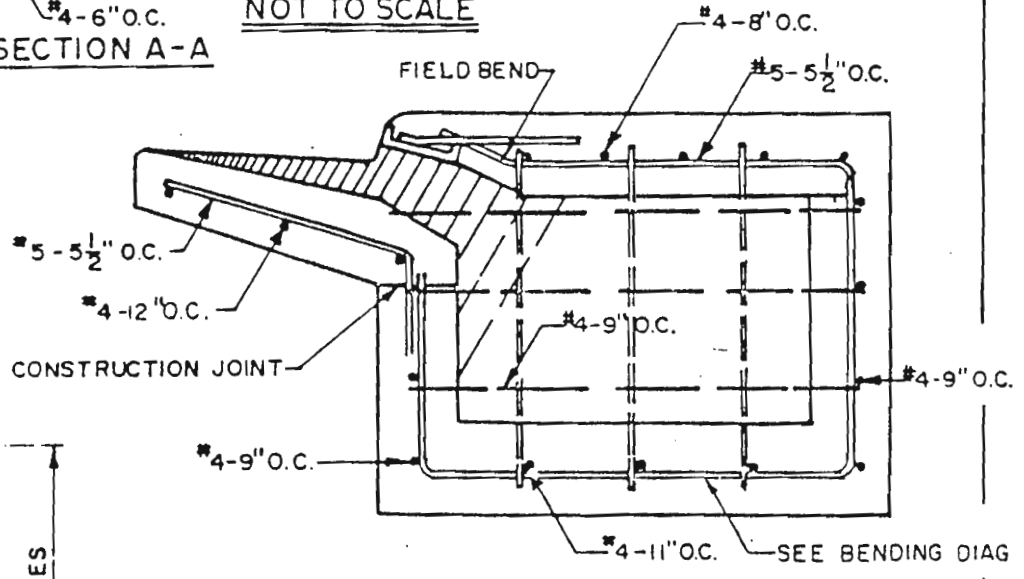
COLORADO DEPT OF HWYS

TYPE "R" INLET

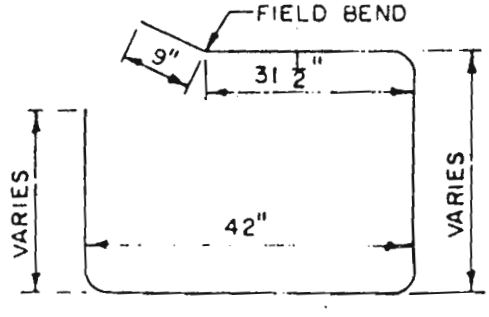


SECTION A-A

NOT TO SCALE



SECTION C-C & D-D
(Dotted Bars are in Section D-D.)



BENDING DIAGRAM

FIGURE 2-2d

COLORADO DEPT OF HWYS
TYPE "R" INLET

APPROVED SPECIFICATIONS

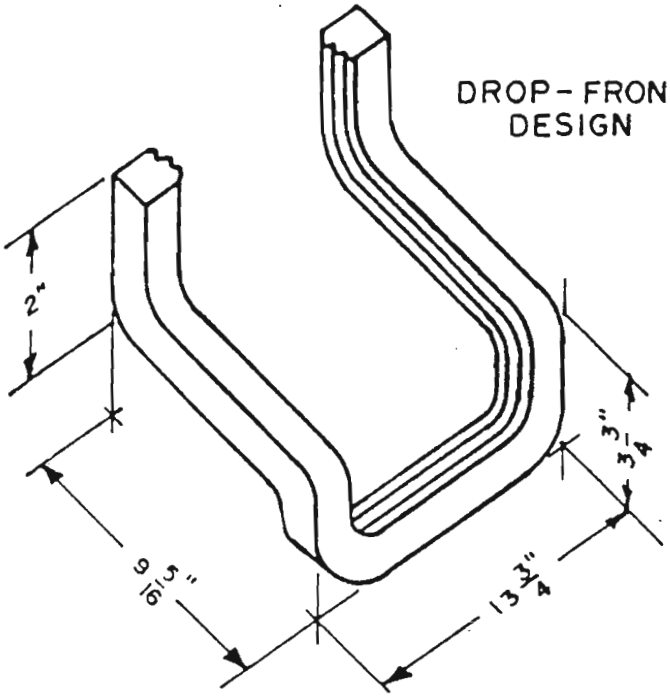
Manhole steps and ladder rungs shall be Alcoa Aluminum Manhole Step part number 126538 or equivalent and shall incorporate two nonskid grooves not to exceed 1/8" deep and 1/8" wide. They shall be made of aluminum alloy conforming to Federal Specification QQ-A-200/8, having a minimum tensile strength of 38,000 p.s.i. and a minimum yield strength of 35,000 p.s.i. They must have an elongation of not less than 10 percent in 2 in., and must carry a load in the center of the cross bar of 1,000 lb. when projected 6 in. from the wall and 1,500 lb. when projected 4 in. from the wall without permanent deformation.

WEIGHT: 2.23 pounds

NOTE: Manhole steps to be set at 16 in. maximum rung distance.
Manhole steps shall be poured in place.

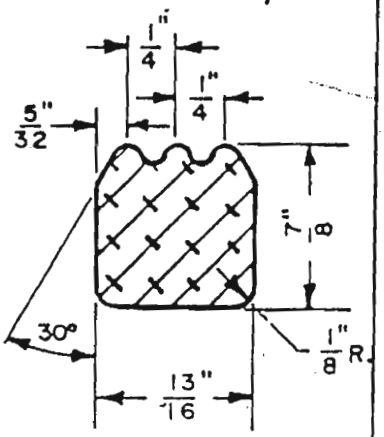
*ALCOA ALUMINUM SPECIFICATIONS

DROP-FRONT DESIGN



NOT TO SCALE

TYP. CROSS SECTION ON ALL STEPS



PHYSICAL AND MECHANICAL PROPERTIES

CAPACITY:
1000 lb. with step extended 6 in. from wall.
1500 lb. with step extended 4 in. from wall.
Load applied at center of step
Load based on no permanent deformation

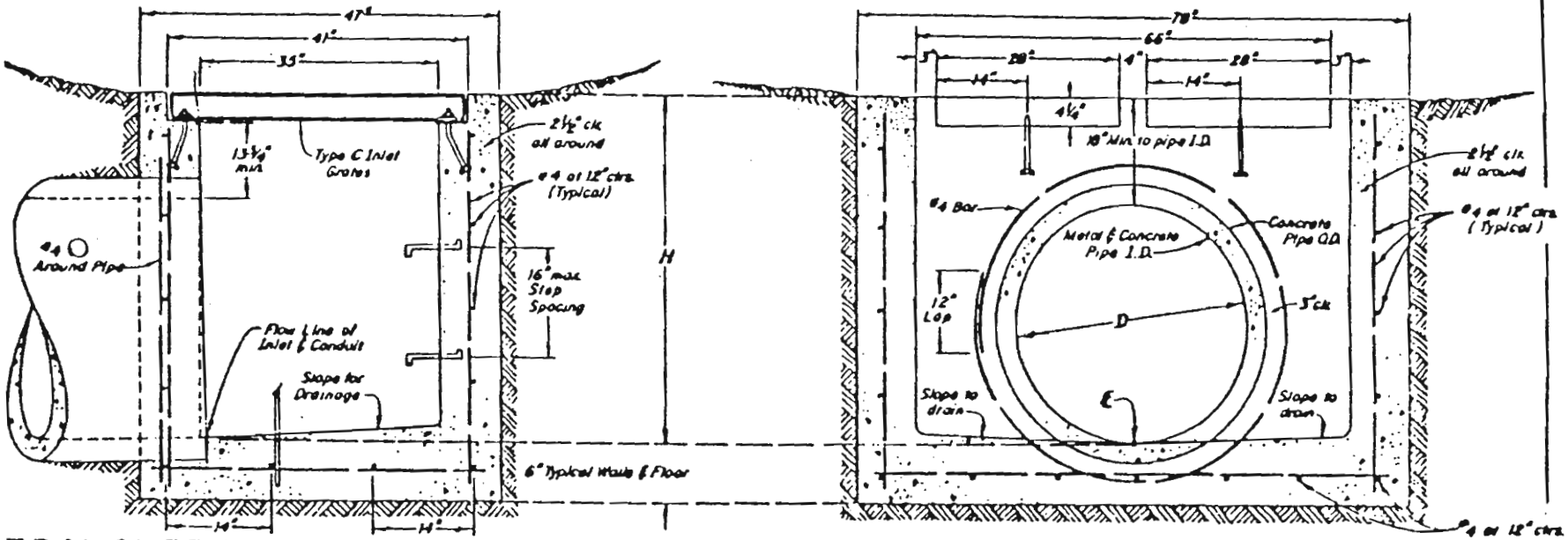
ALLOY:
Alcoa aluminum-magnesium-silicide-type alloy conforming to Federal Specification QQ-A-200/8

MECHANICAL PROPERTIES:
Tensile strength-38,000 p.s.i (min.); Yield strength-35,000 p.s.i. (min.); Elongation-10% in 2 in. (min.).

NOMINAL CHEMICAL COMPOSITION:
Magnesium-1.00%; Silicon-0.60%, Copper-0.25%
Aluminum and normal impurities constitute remainder.

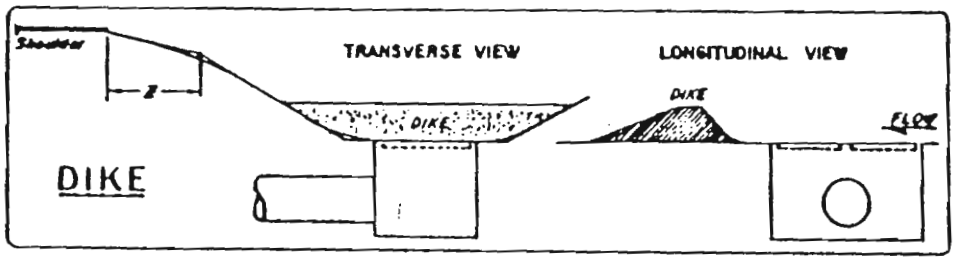
FIGURE 2-2e

COLORADO DEPT OF HWYS
TYPE "R" INLET

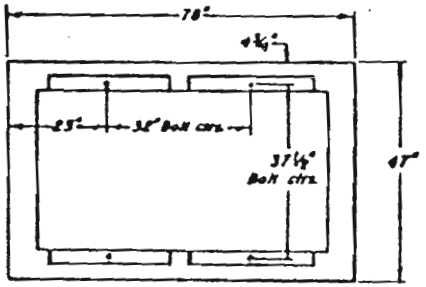


TRANSVERSE CROSS SECTION

LONGITUDINAL CROSS SECTION



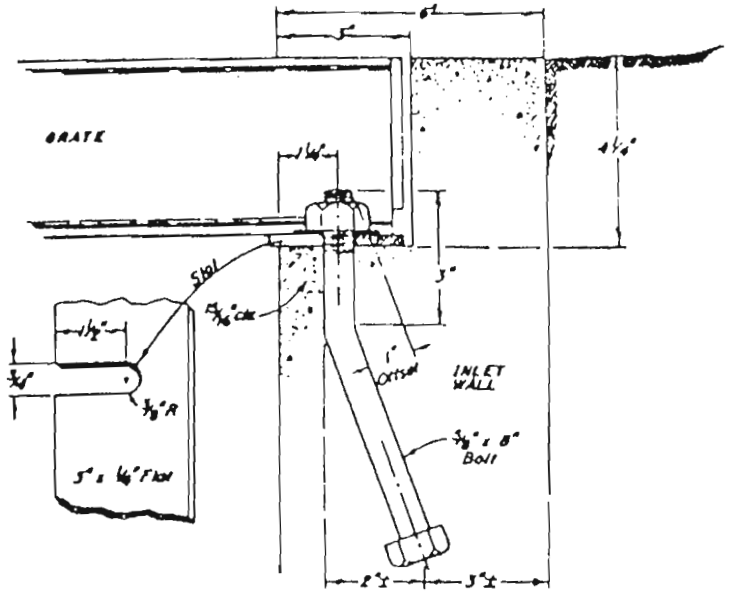
DIKE



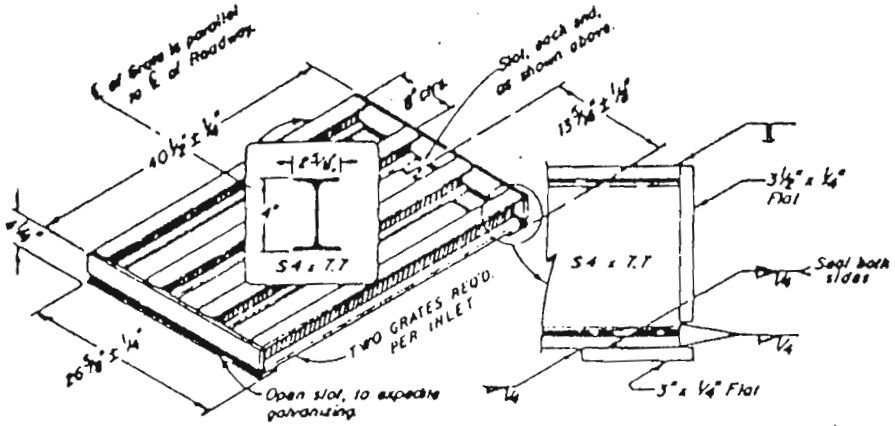
PLAN VIEW
SHOWING ANCHOR BOLT LAYOUT

FIGURE 2-3a

COLORADO DEPT OF HWYS
TYPE "D" INLET



GRATE INSTALLATION DETAIL



TYPE "C" INLET GRATE

QUANTITIES FOR ONE INLET

H ft.	CONCRETE ▽ cu yd	STEEL ▽ lb	PIPE RANGE, D in. CSP	PIPE RANGE, D in. RCP	STEEL RING * CSP lb.	STEEL RING * RCP lb.	NO. STEPS REQ'D.
3.0	1.5	109	18	18	5	6	0
3.5	1.7	115	18-24	18-24	6	7	0
4.0	1.9	134	18-30	18-30	7	9	1
4.5	2.0	140	18-36	18-36	9	10	1
5.0	2.2	159	18-42	18-42	10	11	2
5.5	2.4	165	18-48	18-48	11	12	2
6.0	2.6	184	18-54	18-48	12	12	2
6.5	2.7	190	18-60	18-48	13	12	3
7.0	2.9	209	18-66	18-48	14	12	3
7.5	3.1	215	18-66	18-48	14	12	4
8.0	3.3	234	18-66	18-48	14	12	4
8.5	3.4	240	18-66	18-48	14	12	4
9.0	3.6	259	18-66	18-48	14	12	5
9.5	3.8	265	18-66	18-48	14	12	5
10.0	4.0	284	18-66	18-48	14	12	5

▽ Concrete and Steel quantities are for ONE entire Inlet before deduction for volume occupied by pipe.

* Steel Ring weights are for the maximum pipe D shown.

QUANTITIES: 2 STEEL GRATES - ONE INLET

NO PIECES	DESCRIPTION	LENGTH	Lb per Ft	WEIGHT (lbs.)
8	S4 x 7.7 Beam	40"	7.70	206
4	3 1/2" x 1/4" Flat	26 7/8"	2.98	26
4	3" x 1/4" Flat	26 7/8"	2.55	24

TOTAL 256 lbs.

GENERAL NOTES

All work shall be done in accordance with the Standard Specifications applicable to the project

Concrete shall be Class A, B, or D.

See plans for size and location of Conduit.

Inlet Grating shall be galvanized as described for Frames, Grates, Covers & Steps in Section 712

All exposed concrete surfaces shall receive Class I Finish.

Footings in rock shall be poured out to rock and not formed.

Inlet may be Cast-in-Place or Precast.

Steps will be required when Inlet "H" exceeds 3'-6".

For detail of Inlet Step, see Standard M-604-D.

Steps shall be included in the cost for "Inlet, Type D".

Grating shall conform to Section 604.

FIGURE 2-3b

COLORADO DEPT OF HWYS

TYPE "D" INLET

TOWN OF LYONS
SECTION 2
STORM DRAINAGE SYSTEM

2.1 DESIGN CRITERIA

2.1.1 SUBMISSIONS:

1. Storm Drainage Public Improvement Plans: The public improvement plans shall describe the proposed storm drainage system in adequate detail so as to serve as construction drawings as well as satisfying the requirements of this section.

2. Preliminary Storm Drainage Report: A storm drainage report is required by the subdivision regulation with the Preliminary Plan Submittal. The purpose of the preliminary storm drainage report is to present a conceptual plan for the proposed storm drainage system prior to actual sizing of facilities. The preliminary drainage report shall include, but not be limited to the following:
   a) A map of the watershed in which the development is located with sufficient detail to identify the flow-paths of storm drainage to and from the development to a major drainage way.
   b) Identify nearby irrigation ditches and reservoirs to be affected by storm drainage from the development.
   c) Coefficients and calculations for determining historical and developed flo9ws for the minor (2-year) and the major (100 year) storm.
   d) The storm drainage public improvement plans which shall include:
      1. The drainage area boundary and drainage sub-area boundaries in which the subdivision is located.
      2. Existing and proposed contours at two foot intervals where the average cross slope is less than ten percent and at five foot intervals where the cross slope exceed ten percent.
      3. Finish grade for all lots ad streets indicating flow directions.
      4. Existing drainage facilities and structures including irrigation ditches, roadside ditches, drainageways ad culverts.
      5. Proposed drainage facilities and structures including piping and open drainageways, inlets, manholes, culverts and other appurtenances.
      6. The proposed outfall points for runoff from the subdivision.
      7. Routing and accumulative flows at various critical points for the minor and the major storm runoff.

3. Final Storm Drainage Report: The final storm drainage report shall be submitted with the final plat as a further development of the preliminary storm drainage report and shall include the following:
   a) Street capacity calculations at critical street sections for the minor and major storm runoff.

   b) Hydraulic grade lies for all storm sewers for the minor and major storms.

c) Backwater profiles for open channel for the minor and major storm runoff with input data and procedures used for the calculations.

d) Results of culvert design calculations with all input data and procedures used.

e) Inflow and outflow design hydrographs for detention facilities.

f) Stage volume curves, outlet rating curves, spillway rating curves, and the method used to determine the rating curves.

g) An erosion control plan, where soil and slope conditions dictate. This plan should indicate methods to be used during and after construction to control erosion and sediment in the development.

h) A statement which describes the safety hazards that may be associated with the various drainage structures and the provisions that have been included in the design to minimize safety hazards.

2.1.2 METHOD: runoff from minor and major storms must be computed before the drainage system can be destined. Two computat8ional techniques are recommended for determining runoff using rain intensities from Table 2-1.

1. Rational Method: This method is recommended for storm sewer, culvert design, and overland flow from areas generally less than 200 acres. The Rational Method is applicable to both minor and major storm runoff.
2. Colorado Urban Hydrograph Procedure (CUHP): This method is recommended for areas from 50 to 40000 acres with relatively flat slopes that will undergo significant urbanization.

2.1.3 CRITERIA: The following design criteria shall be utilized in the design of the subdivision storm drainage system:

1. Streets and Gutters: Allowable street and cross street flow for the 2 year and 100 year storm is given in Table 2-2. Culverts should be sued when it is necessary to transport runoff across streets without curb and gutter. Minimum grade for all gutters shall be 0.4 percent.
2. Storm Sewers: The storm sewer systems and subsequent storm inlets shall commence at all locations where the allowable street capacity is exceeded or wherever ponding of water is likely to occur due to the 2 year storm.
   a. Pipe size: The average flow velocity in any conduit shall not be less than 2.0 feet/second. All storm sewers shall be of sufficient structural strength to withstand and AASHO H-20-44 loading. The minimum allowable pipe sized for storm sewers shall be 15 inches for all sewers or a minimum cross-sectional area of 1.23 square feet. If non circular sections are used the minimum dimension shall be 12 inches to provide space for cleaning equipment.
   b. Manholes: Manholes shall be placed wherever there is a change in size direction, elevation or slope, where there is a junction of two or more systems or laterals, or when the maximum allowable distance is reached, as follows:

Vertical pipe dimension	Max. allowable distance between Manholes and/or cleanouts
15 – 36 inches	400 feet

TABLE 2-1
RAINFALL ITENSITY-DURATION TABLES
LYONS, COLORADO

RETURN PERIOD = 2 YEARS					RETURN PERIOD=100 YEARS				
Duration (min)	Total Depth (in)	Incremental Depth (in)	Design Rain (in)	Intensity (in/hr)	Duration (min)	Total Depth (in)	Incremental Depth (in)	Design Rain (in)	Intensity (in/hr)
10	0.47	0.47	0.06	2.82	10	1.21	1.21	0.18	7.26
20	.68	.21	.09	2.05	20	1.78	0.57	.19	5.34
30	.82	.14	.21	1.64	30	2.12	.34	.57	4.24
40	.91	.09	.47	1.37	40	2.31	.19	1.21	3.47
50	.98	.07	.14	1.18	50	2.50	.19	.034	3.01
60	1.04	.06	.07	1.04	60	2.68	.18	.19	2.68
70	1.08	.04	.04	.093	70	2.81	.13	.13	2.41
80	1.12	.04	.04	.84	80	2.88	.07	.07	2.16
90	1.16	.04	.04	.77	90	2.93	.05	.05	1.96
100	1.20	.04	.04	.72	100	2.98	.05	.05	1.79
110	1.23	.03	.03	.67	110	3.03	.05	.05	1.65
120	1.26	.03	.03	.63	120	3.08	.05	.05	1.54
130	1.29	.03	.03	.59	130	3.13	.05	.05	1.44
140	1.32	.03	.03	56	140	3.18	.05	.05	1.36
150	1.35	.03	.03	.54	150	3.23	.05	.05	1.29
160	1.37	.02	.02	.51	160	3.28	.05	.05	1.23
170	1.39	.02	.02	.49	170	3.32	.04	.04	1.17
180	1.41	.02	.02	.47	180	3.36	.04	.04	1.12
TOTAL		1.41	1.41		TOTAL		3.36	3.36	

From NOAA Atlas, volume III, Colorado 1973.

FIGURE 2-1

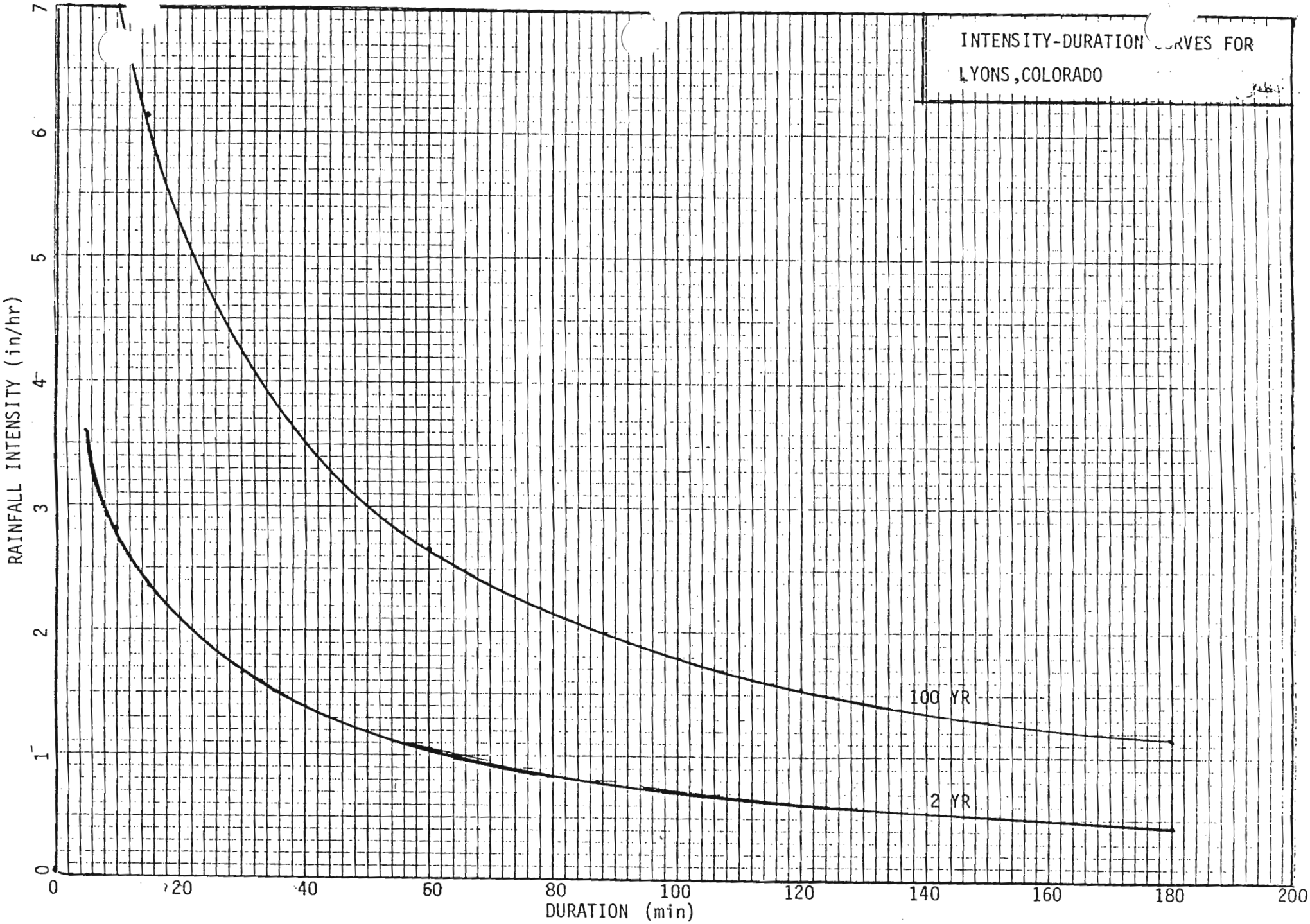

INTENSITY-DURATION CURVES FOR
LYONS, COLORADO
RAINFALL INTENSITY (in/hr)
0
1
2
3
4
5
6
7
0
20
40
60
80
100
120
140
160
180
200
DURATION (min)
100 YR
2 YR

TABLE 2-2

Allowable Use of Streets and of Cross Street Flow as Part of Drainage system During Minor and Major Storm Runoff

Street Classification	Minor Storm Runoff (Maximum roadway encroachment)	Major Storm runoff (Allowable depth & inundation)
Local	No Curb overtopping; where no curbing exists, encroachment shall not extend over property lines. Flow may spread to crown of street.	Inundation: Residential dwellings, public, commercial and industrial buildings shall not be inundated at ground line, unless buildings are flood-proofed. Depth or water over gutter flowline shall not exceed 18"
Collector	No curb overtopping: (same as above) Flow spread must leave at least one lane free of water.	(Same as above)
Arterial	No curb overtopping: (Same as above). Flow spread must leave at least one lane free of water in each direction.	Inundation: (same as above). Depth of water at street crown shall not exceed 6", to allow operation of emergency vehicles. Dept of water over gutter flowline shall not exceed 18".

Allowable Cross Street Flow

Local	Where cross pans allowed, depth of flow shall not exceed 6".	Depth of water over gutter flowline shall not exceed 18"
Collector, Arterial	None	Depth of water at crown shall not exceed 6".

37 – 60 inches	500 feet
61 inches and larger	750 feet

c. Inlets, outlets, and curb openings: Storm sewer inlets shall be designed so that the encroachment of gutter flow on the street or intersection does not exceed requirements of Table 2-2.
The only inlet type allowed on streets with curb and gutter will be the Colorado Department of Highways Type R inlet. For drainageways other than streets *(for example, parking lots, medians, sump basins), the Colorado Department of Highways Type D area inlet shall be used. See Figure 2.3 for details.
All curb openings shall be installed with the opening at least 2 inches below the gutter slope.
The outlet pipe of the storm inlet shall be sized o the basis of the theoretical capacity of the inlet, with a minimum diameter or equivalent diameter of 15 inches.
Because of possible debris plugging, pavement overlaying, parked vehicles, and other factors which decrease inlet capacity, the reduction factors to be used shall be:

Drainage of condition Of street	Inlet type	Percentage of theoretical capacity
Sump	Comb. curb opening	80
Continuous grade	(R) and area inlet (D) Curb opening (R)	80

Continuous grade refers to a street that has continuous slope past the inlet. Sump conditions exist whenever water is restricted to the inlet area because the inlet is located at a low point.

3. Culverts: Culverts may be of any shape and construction as required by existing topographic features. The size , shape, location, and type of contruction0of culverts shall be subject to the approval of the Town Administrator.

a. Culvert design: The required size of the culvert shall be based up0on adequate hydraulic design analysis. However, to minimize maintenance requirements, the minimum allowable culvert size of r culverts under County roads shall be 18" for circular culverts or a minimum cross sectional area of 1.77 square feet. For culverts in road wide ditches, the minimum size shall be 15" for circular culverts or a 1.23 square foot minimum cross sectional area.
Culverts shall be analyzed to determine whether discharge is controlled by inlet or outlet conditions for both the minor storm discharge and the major storm discharge.
Culvert installations shall be designed with an emergency overflow for the major storm on all streets other than major arterials. Culverts under all streets shall have sufficient capacity to pass the runoff from the major storm and maintain the allowable cross street flow as presented in Table 2-2.
The recommended maximum headwater to diameter rations are:

Storm frequency	Headwater to diameter (HW/D)
10 year	Equal to or less than 1.0
100 year	Equal to or less than 1.5

The values may be exceeded provided excessive ponding above culvert entrances will not cause property or roadway damage, culvert clogging, saturation of fills, detrimental upstream deposits of debris, or inundation of existing or future utilities and structures.

b. Culvert inlets and outlets: Culvert inlets shall be designed to minimize entrance and friction losses. Inlets shall be provided with either flared end sections or headwalls with wingwalls. Projecting ends will not be acceptable. For large structures, provisions shall be made to resist possible structural failure due to hydrostatic uplift forces.
Culvert outlets shall be designed to avoid sedimentation, undermining of the culvert, or erosion of the downstream channel. Outlets shall be provided with either flared end sections or headwalls with wingwalls. Additional outlet control in the form of riprap, channel shaping, etc., may be required where excessively high discharge velocities occur.

4. Open Channels: Natural and man made, lined or unlined open channels are acceptable. Preferably, open channels should be unlined with grass cover, have slow flow characteristics, be wide and shallow, and be natural in their appearance and functioning. However, lined channels will be required where constrictions or excess velocities dictate. All channels must be designed to handle minor and major flows.
This design must give full consideration to esthetics, safety, sediment deposition, and scour, as well as hydraulics.

a. Unlined Channels: For the 100 year storm design flow the following design criteria apply.
    1. Side Slopes: Minimum is 5:1. maximum is 4:1 to allow for mowing equipment.
    2. Depth: The maximum depth should be limited to 3.5 feet, through 4.0 feet is acceptable where good maintenance can be expected and where durations of peak flows are short lived.
    3. Bottom width: The bottom width should be at least 6 to 8 times the depth of flow; 20 to 30 times the depth is common.
    4. Velocity: maximum velocities shall be those normally specified for hydraulic design to provide for an economical cross section and prevent scour problems.
    5. Channel Slope: Grass lined channels, to function well, normally have slopes of from 0.2 to 0.6 percent. Where the natural topography is steeper than desirable, drops should be utilized.
    6. Curvature: Minimum center line curve radius shall be twice the design flow top width or 100 feet, whichever is greater.
    7. Design discharge freeboard: Minimum shall be in general, 1 to 2 feet.
    8. Trickle Channels: Trickle channels or underdrain pipes are required on all grassed channels in urban areas. Trickle channels are preferred because of maintenance. Waterways that are normally dry prior to urbanization will often have continuous base flow after urbanization because of lawn irrigation. A trickle channel is subject to erosion, and must therefore be amply protected with appropriate erosion control devices. Trickle channels should designed to carry 0.5 to 1 percent of the major storm flow.

b. Lined Channels: Lined channels must be designed to withstand the various forces and actions that tend to overtop the bank, deteriorate the lining, and erode unlined areas. Design shall be in accordance with standard hydraulic design procedures for lined open channels.

5. Detention: Storm water detention facilities shall be required where release of storm water will adversely affect areas downstream of development. In general, detention will be required when development will significantly change the historic drainage conditions.
   a. Hydraulic Design: The CUHP is the preferred method for detention design and determination of detention volume. For small basins the method presented in the Denver Regional Council of Governments" Urban Storm Drainage Criteria Manual (1969) may be used. Since the Rational Method does not produce a hydrograph of design purposes, its use is not recommended except for very small basins. Release rates from the detention structures shall not exceed the historical peak runoff rate for the 100 year storm.
   b. Maintenance: The design of a detention structure should include 1) plans for controlling debris and sediment, 2) plans for controlling tickle flows to prevent muddy wet areas, and 3) provisions for adequate slope protection.
   c. Emergency Spillway: The emergency spillway should be designed to avoid overtopping by storms in excess of the major storm, and to avoid overtopping the structure due to clogging of the outlet during the major storm. A minimum of 2 feet of freeboard will be required between the spillway and the top of the embankment. These emergency provisions should include an easement for the overflow path to a major drainageway.
   d. Outlet Facilities: Outlet facilities should be adequate to provide for evacuation of the detention structure within 30 to 36 hours following the major storm. This will allow for multiple day events, which are common to this region.

2.2 SPECIFICATIONS

2.2.1 SCOPE: The work covered by these specifications concerns the furnishing of all labor, equipment and materials and performing all operation for the construction of storm drainage system including streets and gutters, storm sewers, culverts, open channels and detention structures in accordance with these specifications and the Standard Design Drawings in paragraph 2.5.

2.2.2 GENERAL REQUIREMENTS: Work shall be done in accordance with engineered construction plans prepared under the direction of a professional engineer and approved by the Town Administrator. Plans shall conform to the Town's minimum design standards. Where work is to be done on an irrigation ditch, the approval of the ditch owner sis required prior to approval by the Town Administrator. Separation of water mains, storm sewer lines, and sanitary sewer lines, general excavation, trenching, backfill and compaction requirements are specified I the General Specifications, Section 7.

2.2.3 MATERIALS:

1. Pipe Specifications:
   a: Concrete Pipe: Concrete pipe and fittings shall conform to specifications for "Reinforced Concrete D-Load Culvert Storm Drain and Sewer Pipe" ASATM Designation C-655-70T and/or ASTM Designation C-76-70 whichever is designated on the plans or in the Special Provisions and as modified herein:
   Crushing strength requirements for non-reinforced concrete pipe and fillings shall exceed the minimum strength as set forth in ASTM Designation C-14-70 Table 2, by 200 pounds when tested for "Three Edge Bearing", in accordance with ASTM Designation C-497-70a.
   Pipe joist may be either tongue and grooved or bell and spigot. Tongue and grooved shall be cotton fabric diapered and sealed with 1:2 Portland cement sand grout. Bell

and spigot joints shall be conformed to the U.S. Bureau of Reclamation Type R-4 using flexible water tight rubber gaskets conforming to ASTM Designation C-443-70. type II cement containing not more than 5% tricalcium aluminate in accordance with ASTM Designation C-150 shall be used in the manufacture of all pipe.
Pipe seconds, if approved by the Town representative on an individual basis, may be used outside the rights of way of collector or arterial streets and outside the flow lines of residential streets.

b. Corrugated Metal Pipe: Corrugated metal pipe, fittings and bands shall be fabricated in accordance with AASHO M-36 specification and furnished according to the size and gauge designated on the plans or in the Special Provisions. Coupling bands shall be the same metal thickness as the conduit.
Special fittings and elbows shall be the same metal thickness as the conduit to which they are joined and conform of the applicable requirement of AASHO M-36.
Sections on which the spelter coating has been damaged shall be either regalvanized, as provided under AASHO M-36, or painted with one full brush coat of a zinc rich paint (Military Specification MIL-P21035) on properly cleaned surfaces.
Round flexible conduits 54" in diameter and larger shall be preformed to an elliptical shape by elongating the vertical axis 5%. Elongation shall be maintained in the field, by struts, until backfilling is completed.

2. Manholes: Manholes shall be constructed in accordance with the specification of 5.2.3, paragraph 2.

3. Storm Drain Inlets: Inlets shall be Colorado Department of Highways Type "R" or Type "D: as called for in the approved plans. See Figures 2-2 and 2-3.

4. Plugs: A water tight compression plug, as recommended by the manufacturer, shall be installed to seal all dead ends and wyes. At all dead ends and wyes, a 9 gauge steel wire shall be attached to the plug and extended vertically to with in 12" of finish grade, where the wire shall be attached to a 2" x4" x 24" section of timber.

2.3 CONSTRUCTION

2.3.1 GENERAL REQUIREMENTS: Section 7, GENERAL SPECIFICATIONS shall be followed except as modified in paragraph 2.3.2.

2.3.2 SPECIFIC REQUIREMENTS: The following specific requirements shall be followed in the construction of the storm drainage system:

1. Pipe Installation: Lines shall be constructed continuously upgrade from an existing manhole or outlet. Special care shall be taken to lay pipe to exact line an grade. Pipe bedding material shall be placed in the trench bottom, to the thickness specified to provide a uniform and continuous bearing support for the pipe at every point between bell-holes. Preparatory to making pipe joints, all surfaces of the joint shall be clean and dry. Lubricants shall be used as recommended by the pipe manufacturer. The pipe shall be set in position and checked for line and grade using care to keep the joint absolutely free of dirt. When final grade is approved by the Town Inspector, the joint shall be carefully pushed home using appropriate methods of

leverage. Care shall be taken so that the bell end of the pipe will not be deflected to the extent that the gasket is pinched or rolled. Adjustment in line or grade may then be made by working the bedding material around the pipe. Tongue and groove joist shall be sealed by means of a mortar grout held in place with cotton fabric diapers.

If O-ring gaskets are used, immediately after completing the joint, the seating of the gasket shall be checked around the entire circumference of the pipe, by visual and finger inspection. The pipe shall be secured in place by installation of the bedding material tamped under and along the pipe barrel up to spring-line.

All sewers shall be kept thoroughly clean and free from gravel, dirt and debris. Whenever work ceases for any reason, the unfinished end of the pipe shall be securely closed with a temporary tight fitting plug.

The Town Inspector shall be notified at least twenty four hours in advance of when pipe is to be laid in any trench. No pipes shall be covered until they have been inspected by the Town Inspector.

2. Manholes and Cleanouts: Construction of manholes and cleanouts shall be in accordance with 5.2.4, paragraph 4, and the referenced Standard Drawings, Figures 5-3 and 5-4.

3. Connections to Existing Manholes: Connections to existing manholes shall be accomplished in accordance with 5.2.4. paragraph 5.

4. Open Channels and Special Structures: All work shall conform to details shown on the approved plans and accompanying specifications. Construction shall be accurately done to line and grade by using construction stakes placed by field parties under the supervision of an engineer or land surveyor registered in the State of Colorado. The contractor is responsible for placing and maintaining adequate barricades, signs, and warning devices to protect workers and the public.

5. Restoration and Clean Up: The Contractor shall restore or replace all removed or damaged paving, curbing, sidewalks, gutters, sod, shrubbery, fences, irrigation ditches, pipe, or other structures or surfaces to a condition equal to that before the work began and to the satisfaction of the Town Inspector. The construction site shall be left clean and orderly at the end of each work day.

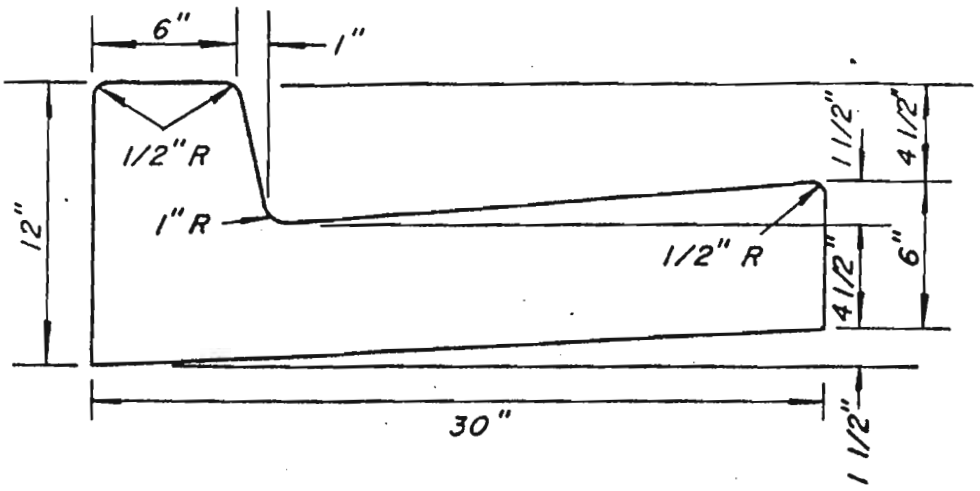
2.4 TESTING

Final acceptance of the sewer line shall be based on an inspection covering all items in this specification. The inspection shall be done in an appropriate manner by the Contractor. Testing of all lien shall be performed by the Contractor in the presence of the Town Inspector. All lines shall lamped and a sewer ball of appropriate diameter may be required to be forced through the line by water at the discretion of the Town Inspector. The Contractor shall remedy, at his own expense, any poor alignment or any other defects in workmanship or materials as found by the Town Inspector. Final acceptance will be based on re-inspection of the sewer after the appropriate repairs and corrections are completed.

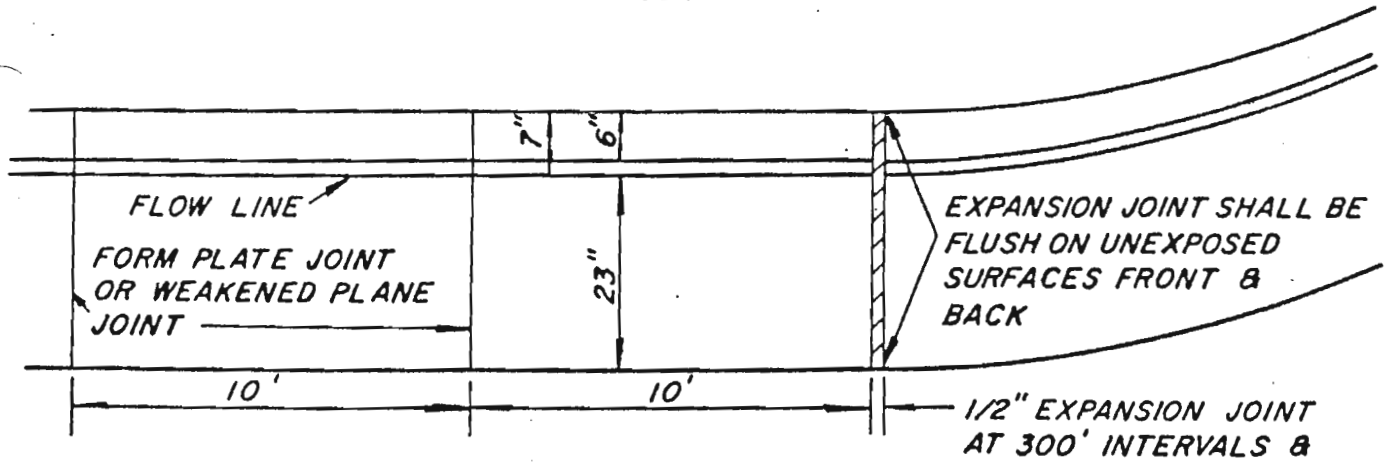
2.5 STANDARD DESIGN DRAWINGS

Figure 2-1 Intensity Duration Curves for Lyons, Colorado
Figure 2-2 Colorado Department of Highway “R” Inlet

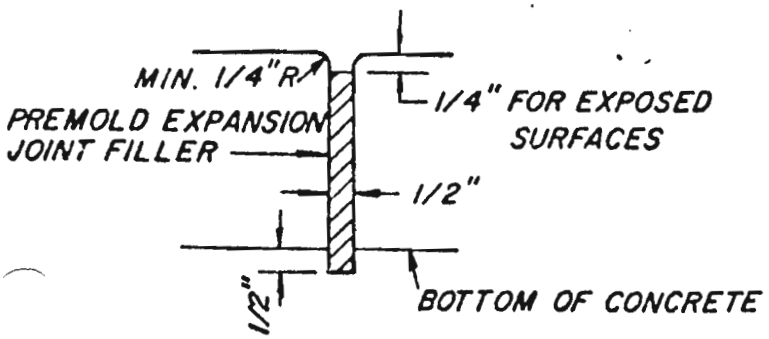
Figure 2-3 Colorado Department of Highway Type “D” Inlet



SECTION



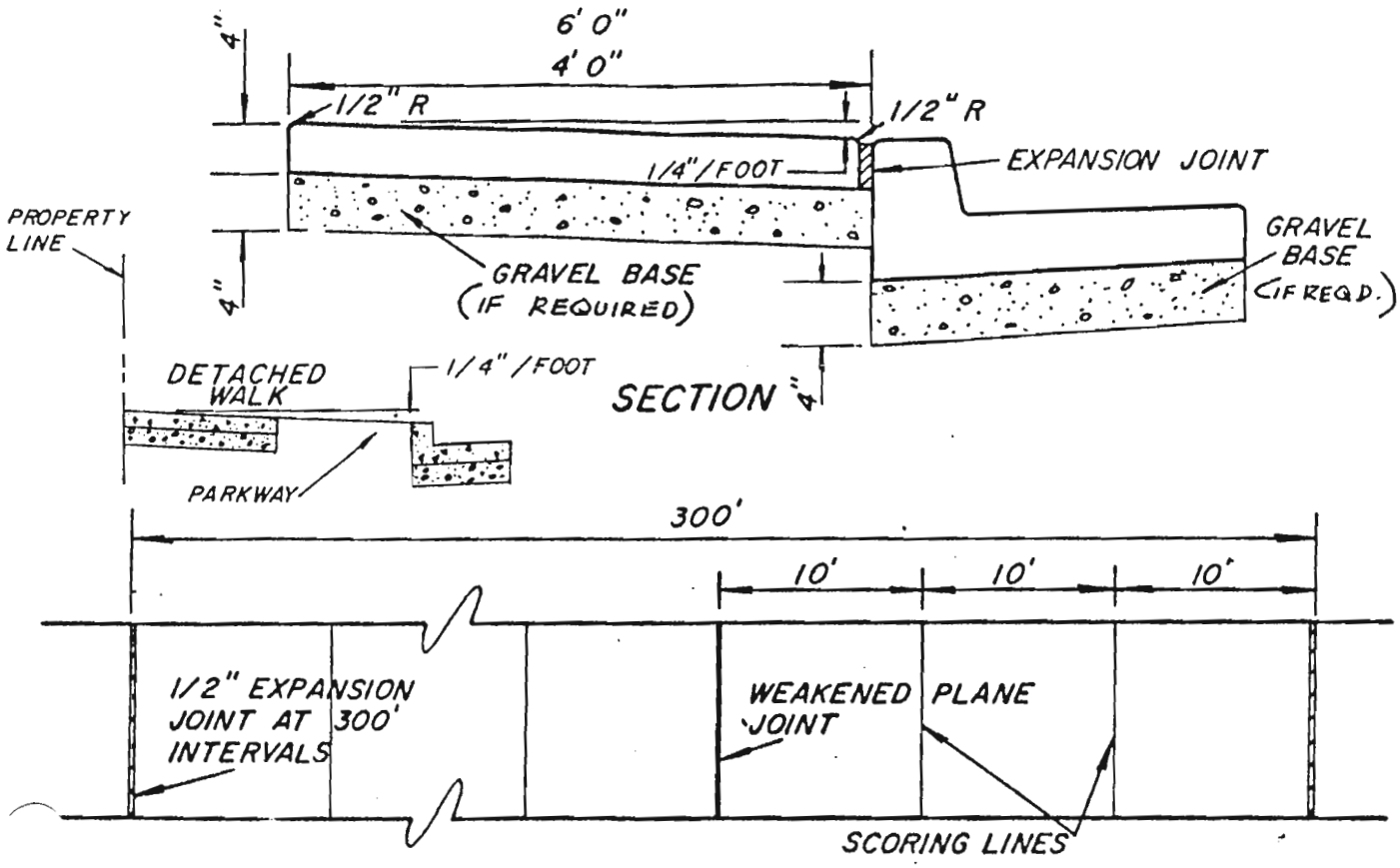
TYPICAL PLAN



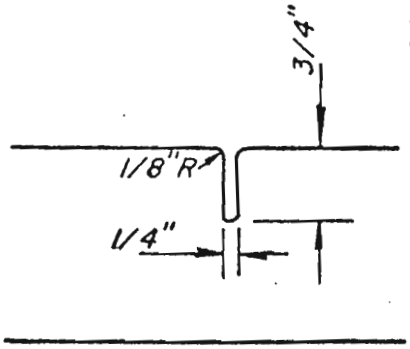
EXPANSION JOINT

FIGURE 3-1

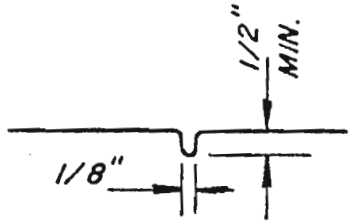
CONCRETE CURB & GUTTER



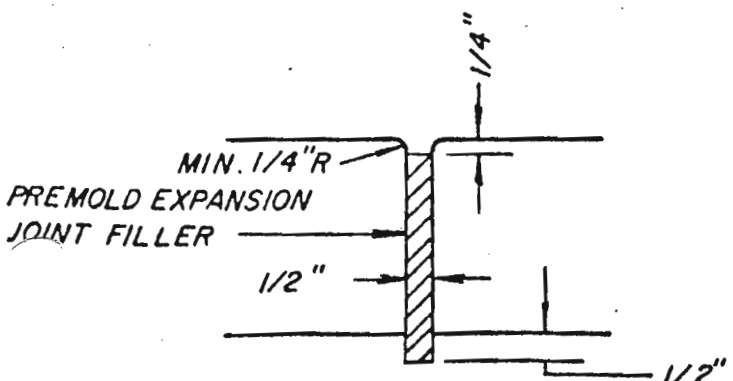
TYPICAL PLAN



WEAKENED PLANE JOINT



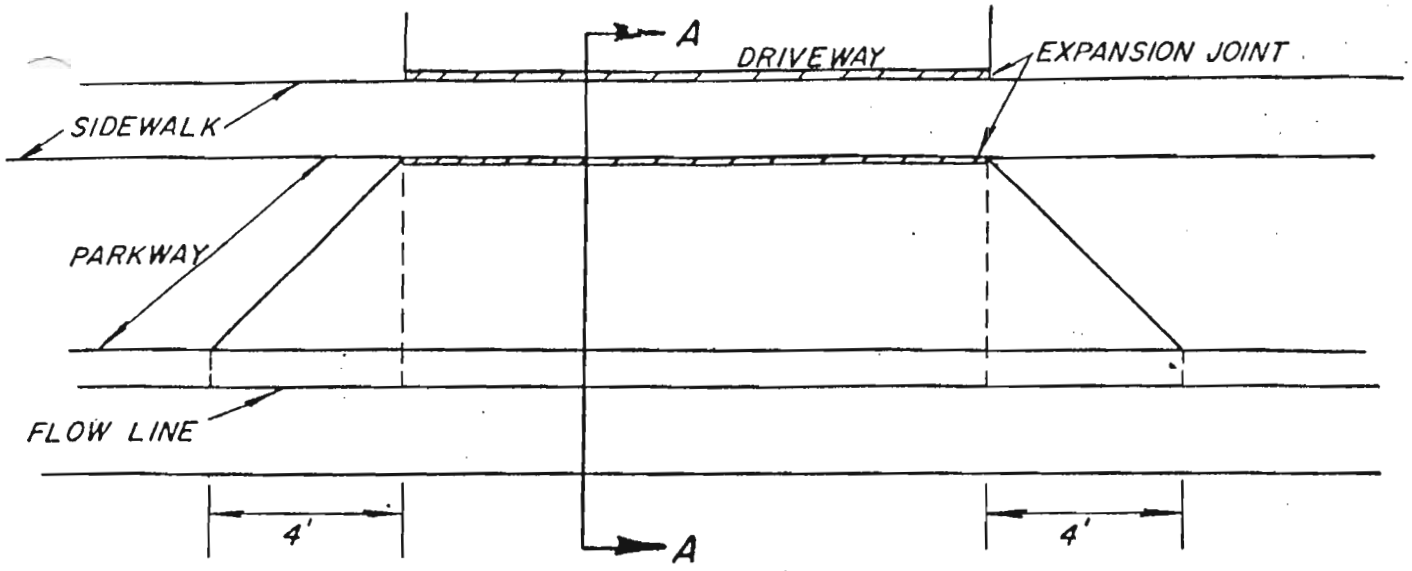
SCORING LINE



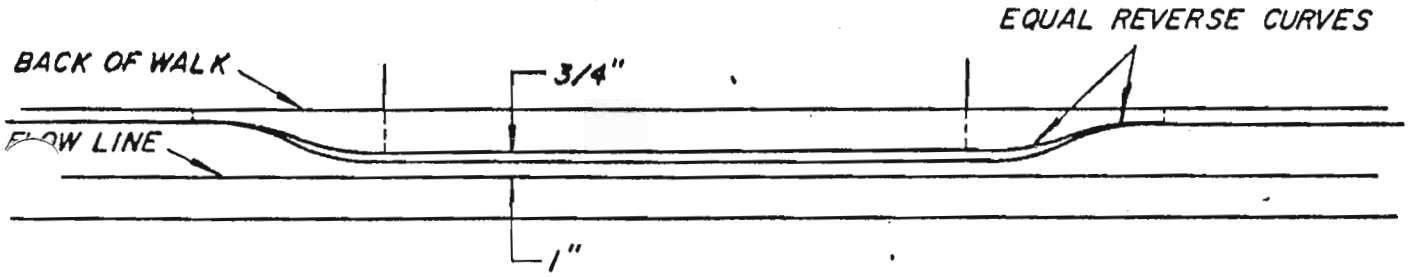
EXPANSION JOINT

FIGURE 3-2

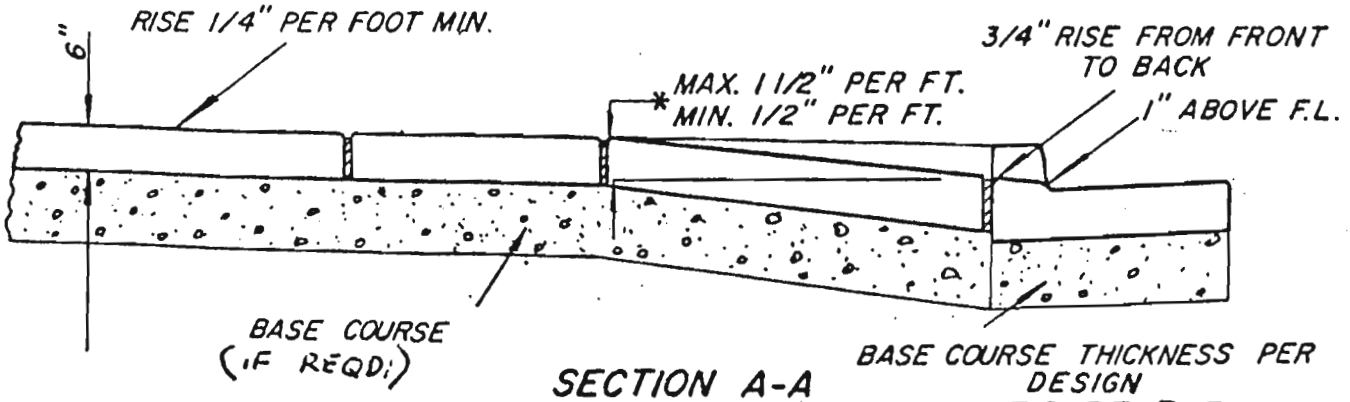
CONCRETE SIDEWALK



PLAN



ELEVATION

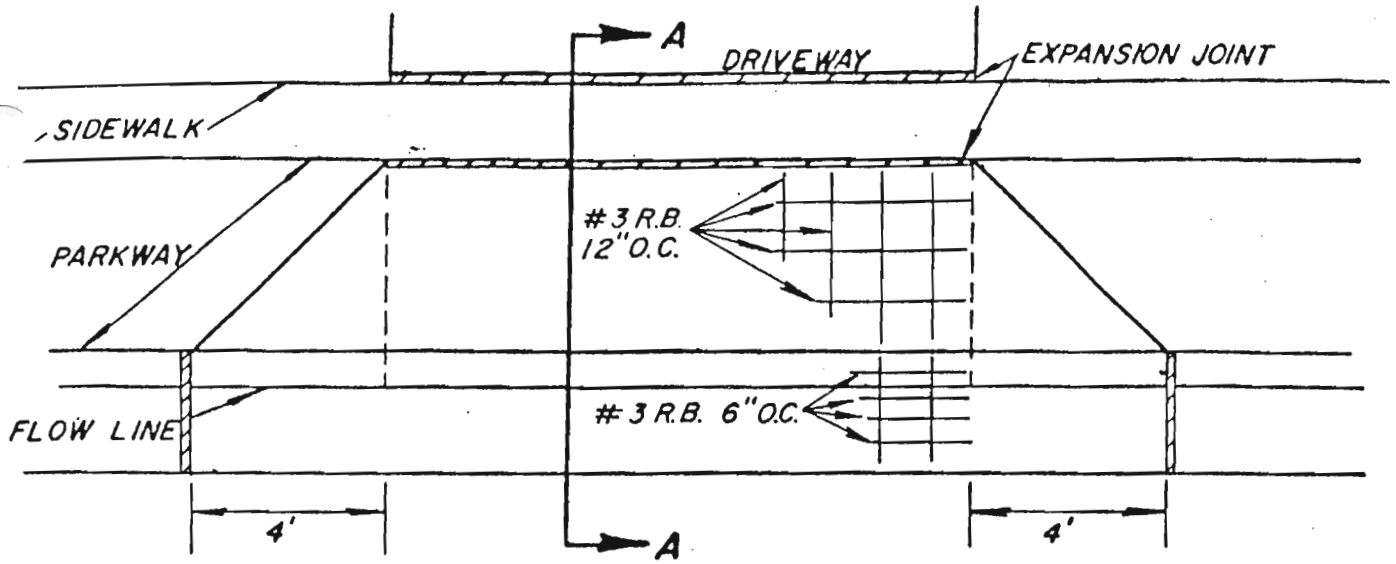


SECTION A-A

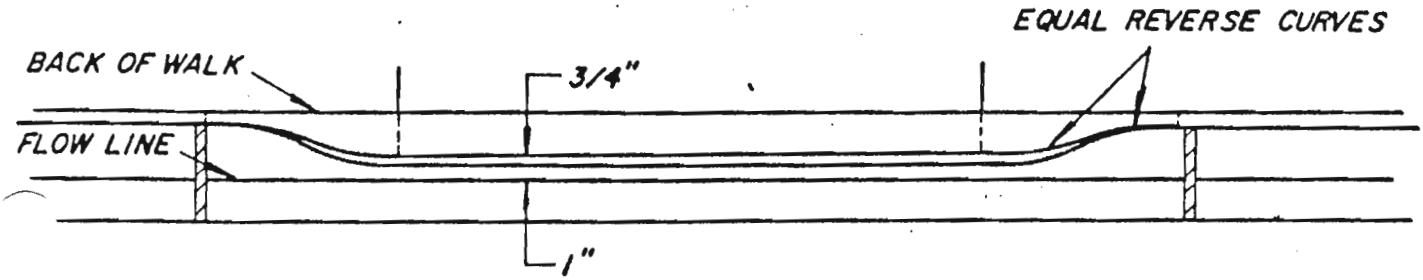
FIGURE 3-3

RESIDENTIAL DRIVEWAY APPROACH

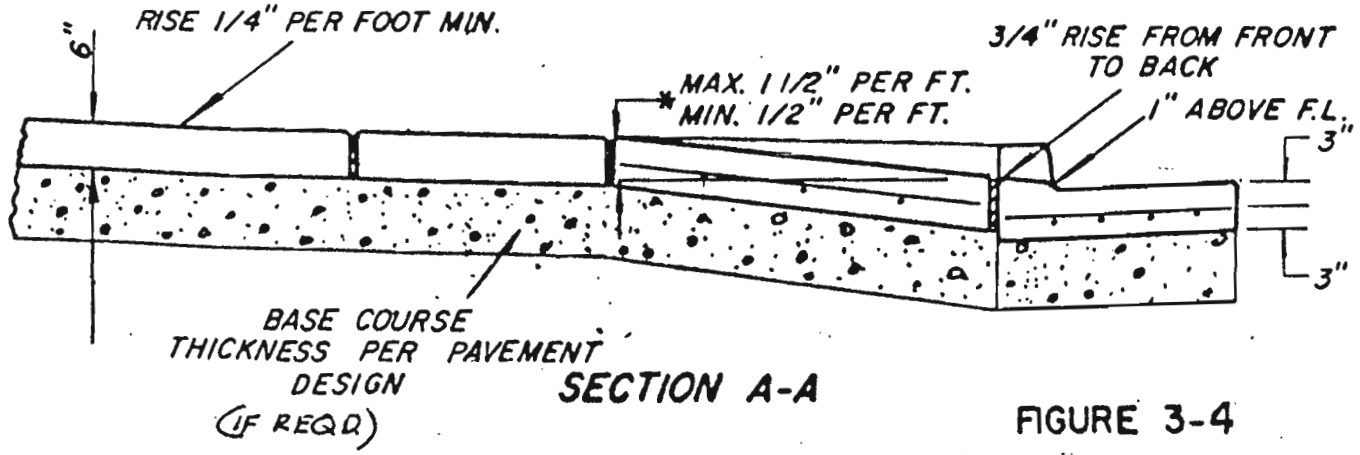
* SLOPE VARIES WITH STREET WIDTHS



PLAN



ELEVATION

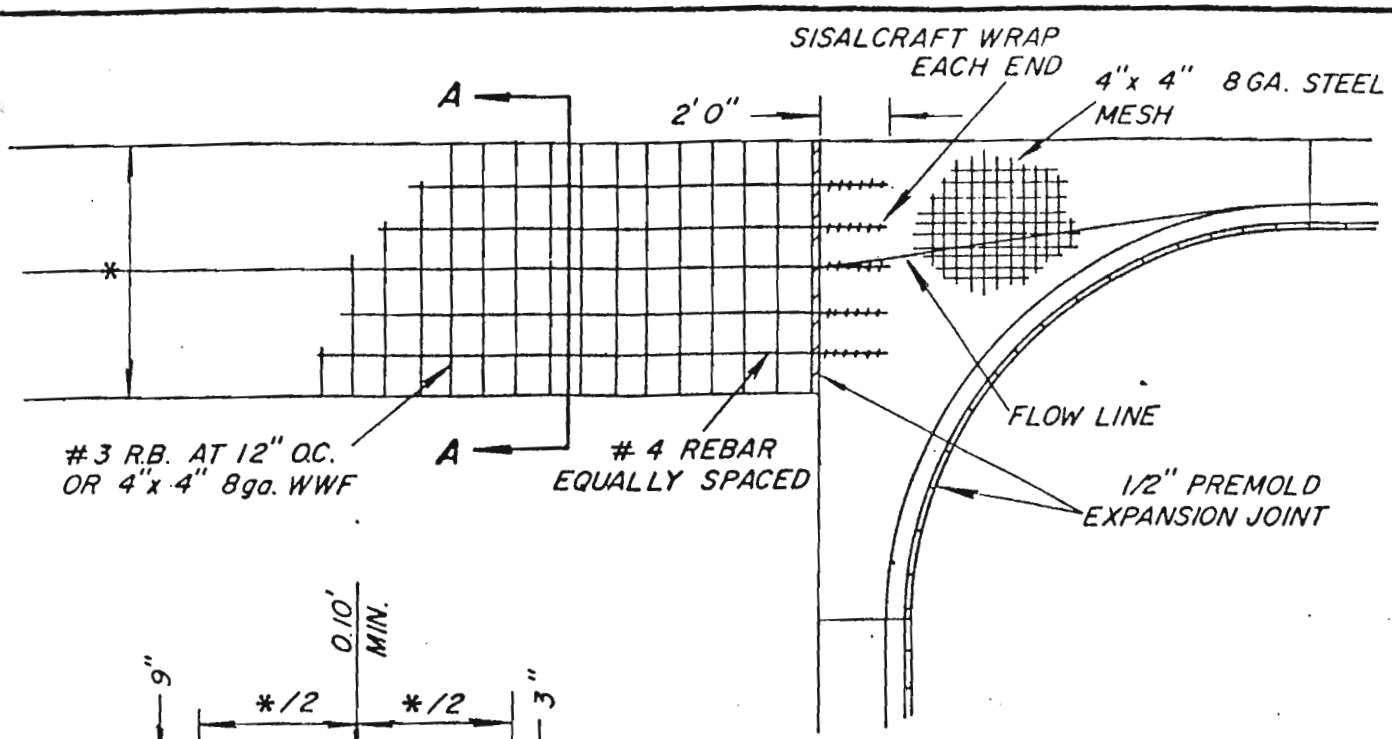


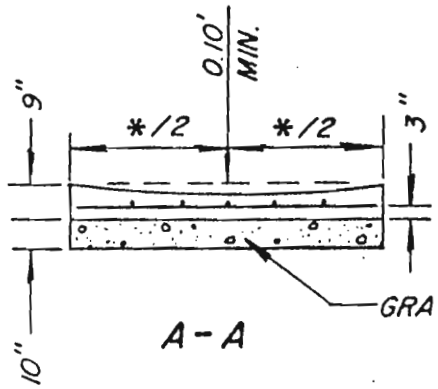
SECTION A-A

FIGURE 3-4

COMMERCIAL DRIVEWAY APPROACH

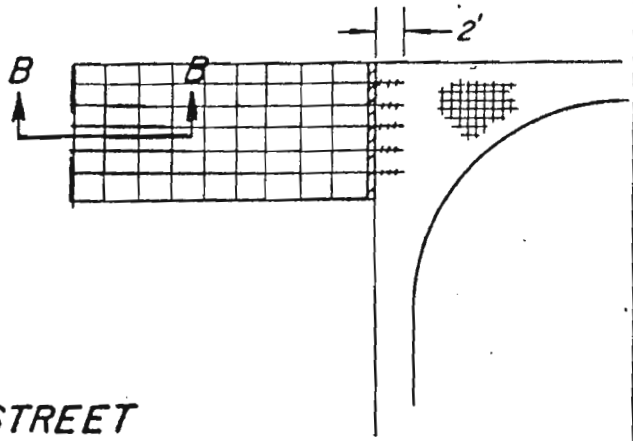
* SLOPE VARIES WITH STREET WIDTHS

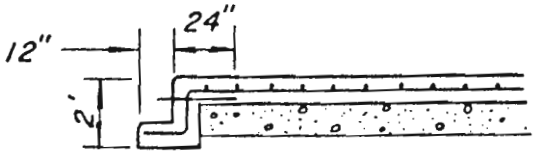




A - A

TYPICAL VALLEY GUTTER





B - B

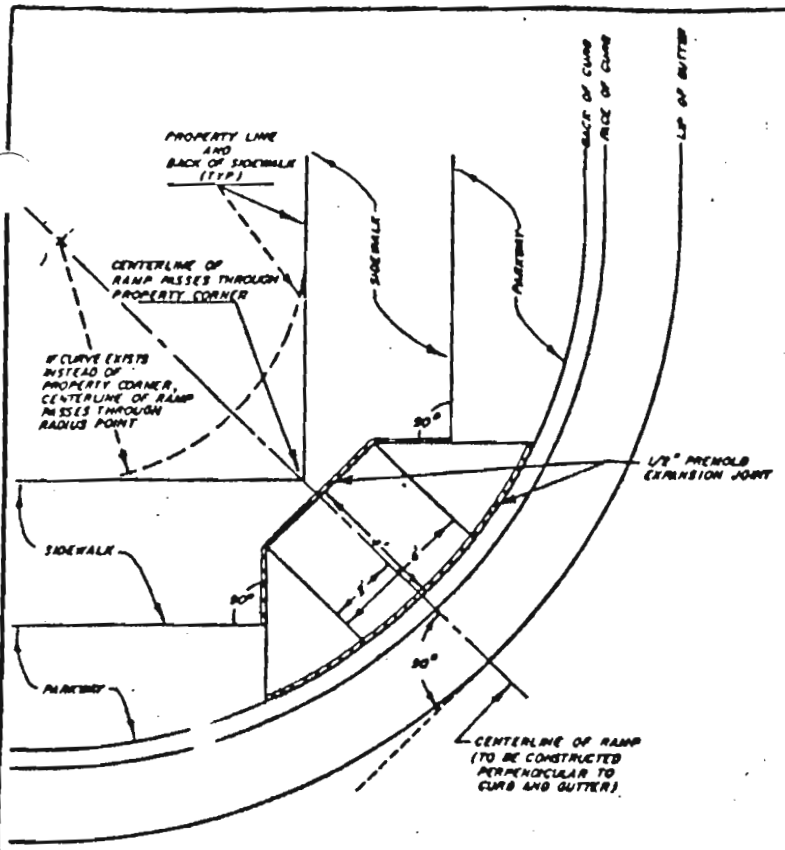
FOR HALF STREET

CONTRACTORS OPTION: CONTRACTOR MAY ELECT TO ELIMINATE THE GUTTER PAN REINFORCEMENT BY PLACING CONCRETE A MINIMUM OF 8" IN THICKNESS.

PARALLEL STREET	* = PAN WIDTH
ARTERIAL	10'
COLLECTOR	8'
LOCAL	6'

FIGURE 3-5

CONCRETE GUTTER PAN



GENERAL NOTES

All work shall be done in accordance with the Standard Specifications applicable to the project.

Minimum width of all Ramps and Sidewalks shall be 4 feet.

Surface of Ramp slope shall have a coarse broom finish with the striations across the slope.

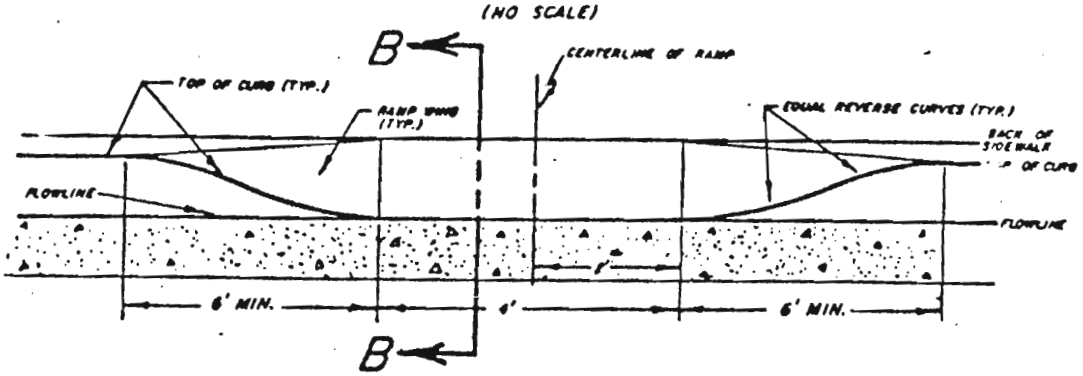
Normal Gutter flow line and profile shall be maintained through the Ramp area.

A 1/2" Expansion Joint will be required where the concrete ramp joins any rigid pavement or structure.

If possible, drainage structures shall not be placed in the 4'x6' Ramps. Location of the Ramp shall take precedence over location of the drainage structure, except where existing drainage structures are being utilized in the new construction.

NOTE:
THE LOCATION OF THE RAMP SHOWN IS SCHEMATIC ONLY. ALL HANDICAPPED RAMPS ARE TO BE CONSTRUCTED TO COINCIDE WITH CROSSWALK MARKINGS USING THE MINIMUM STANDARDS SHOWN.

SECTION A-A
(NO SCALE)



SECTION B-B
(NO SCALE)

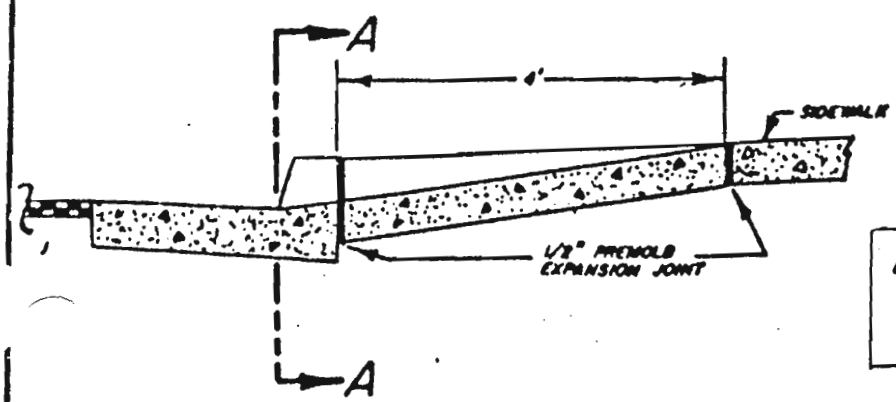
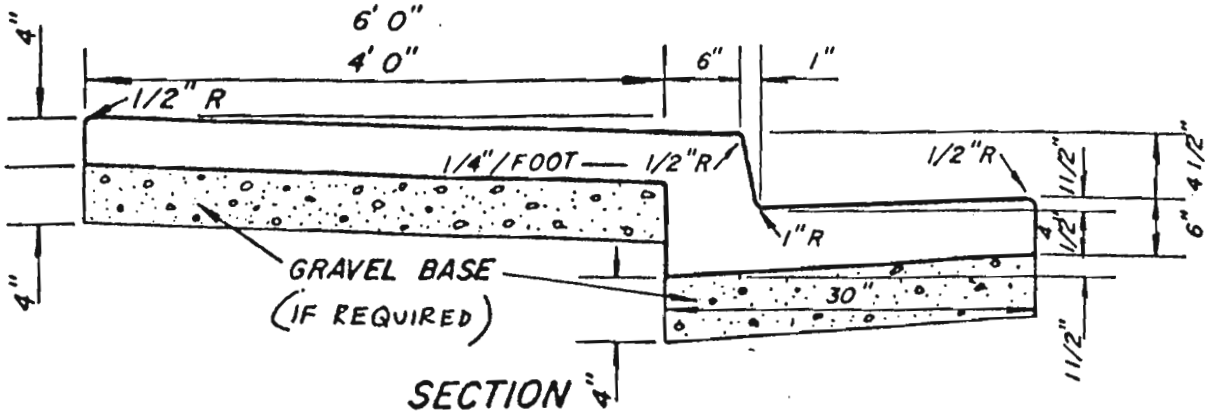
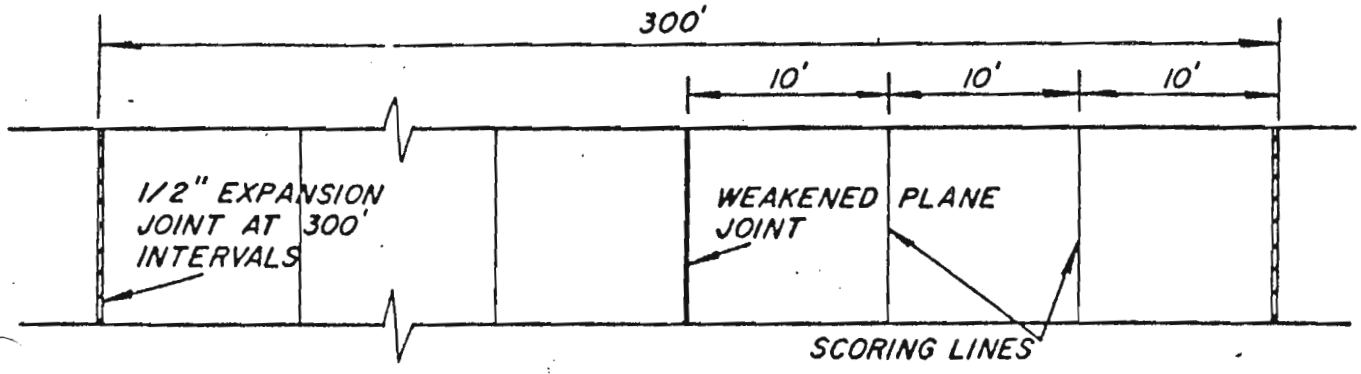


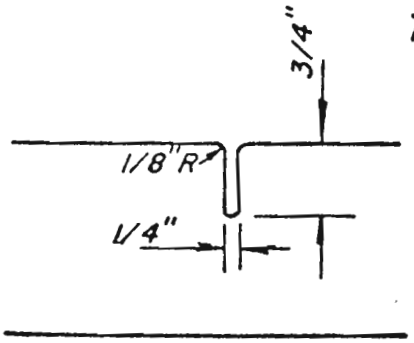
FIGURE 3-6

HANDICAPPED RAMP
TYPICAL STANDARDS

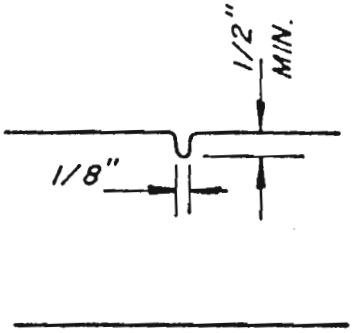




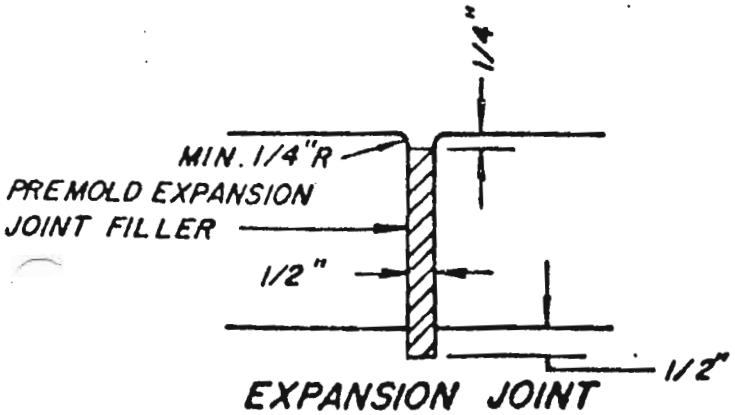
TYPICAL PLAN



WEAKENED PLANE JOINT



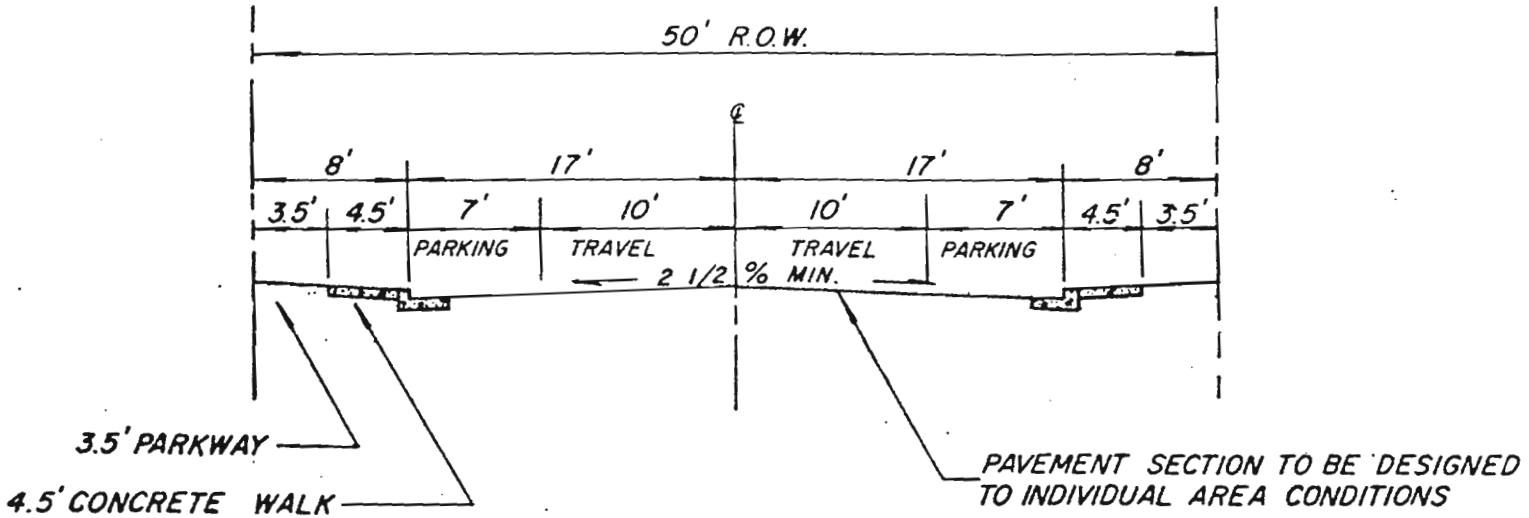
SCORING LINE



EXPANSION JOINT

FIGURE 3-7

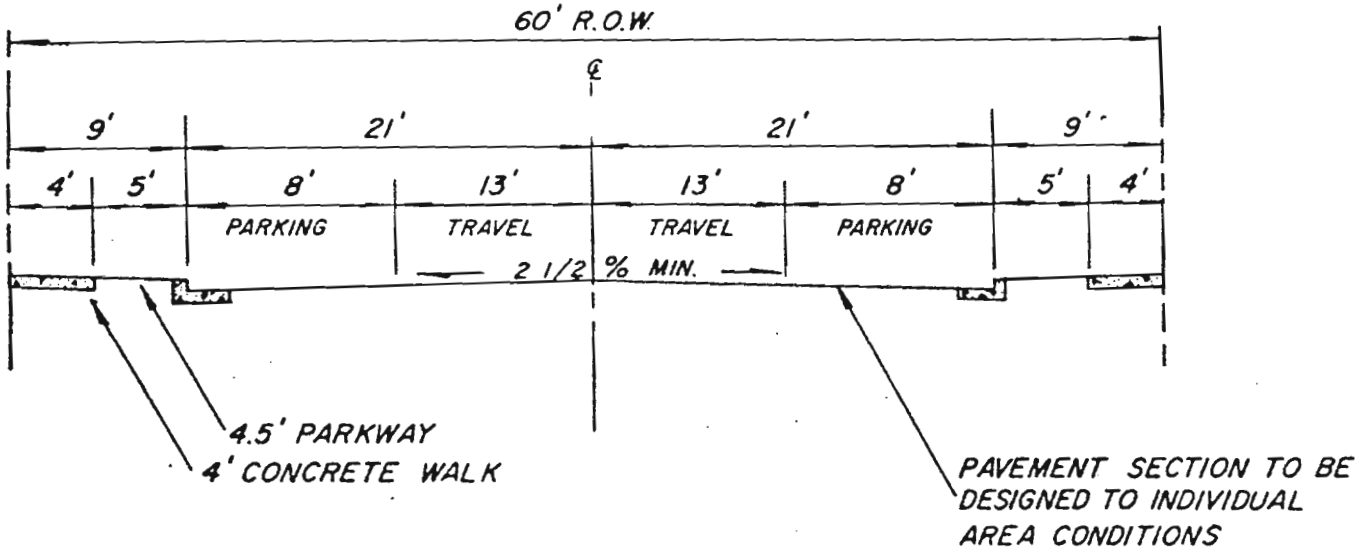
MONOLITHIC
CONCRETE SIDEWALK
AND CURB & GUTTER



34' FACE CURB TO FACE CURB

TYPICAL STREET SECTION
LOCAL - 50' R.O.W.

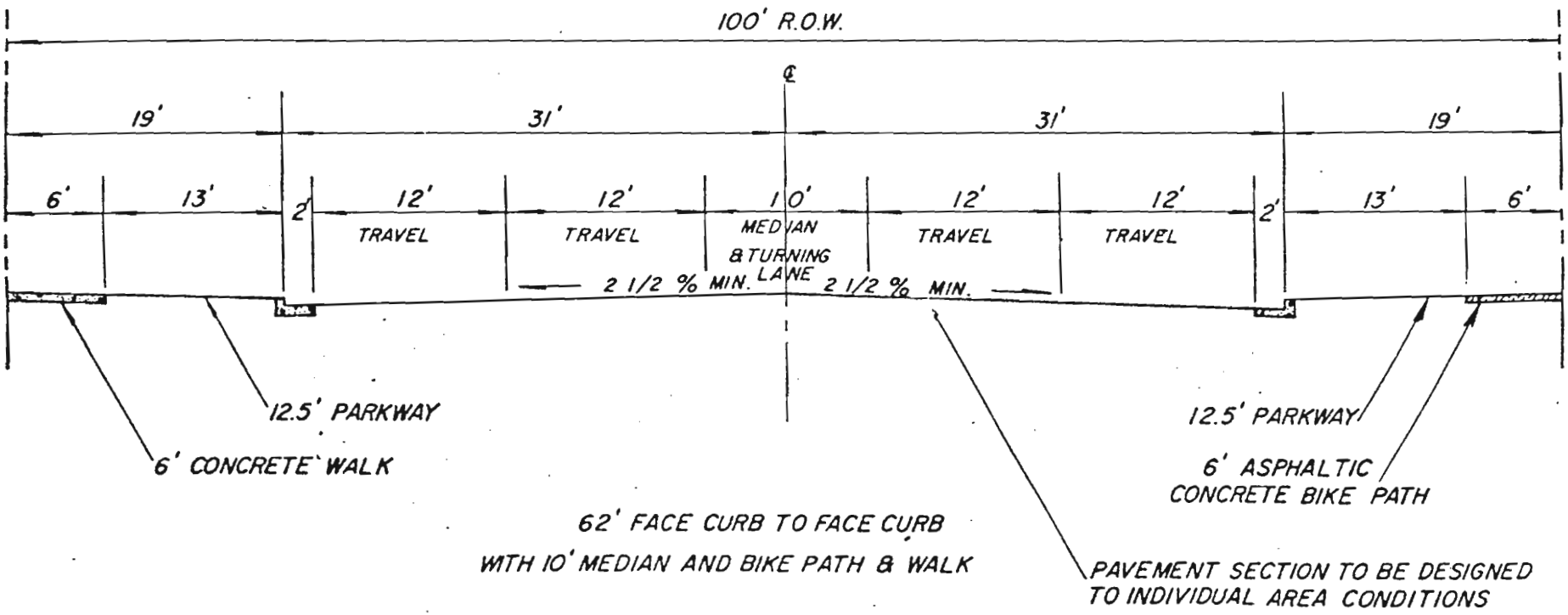
FIGURE 3-8(a)



42' FACE CURB TO FACE CURB

FIGURE 3-8(b)

TYPICAL STREET SECTION
COLLECTOR - 60' R.O.W.

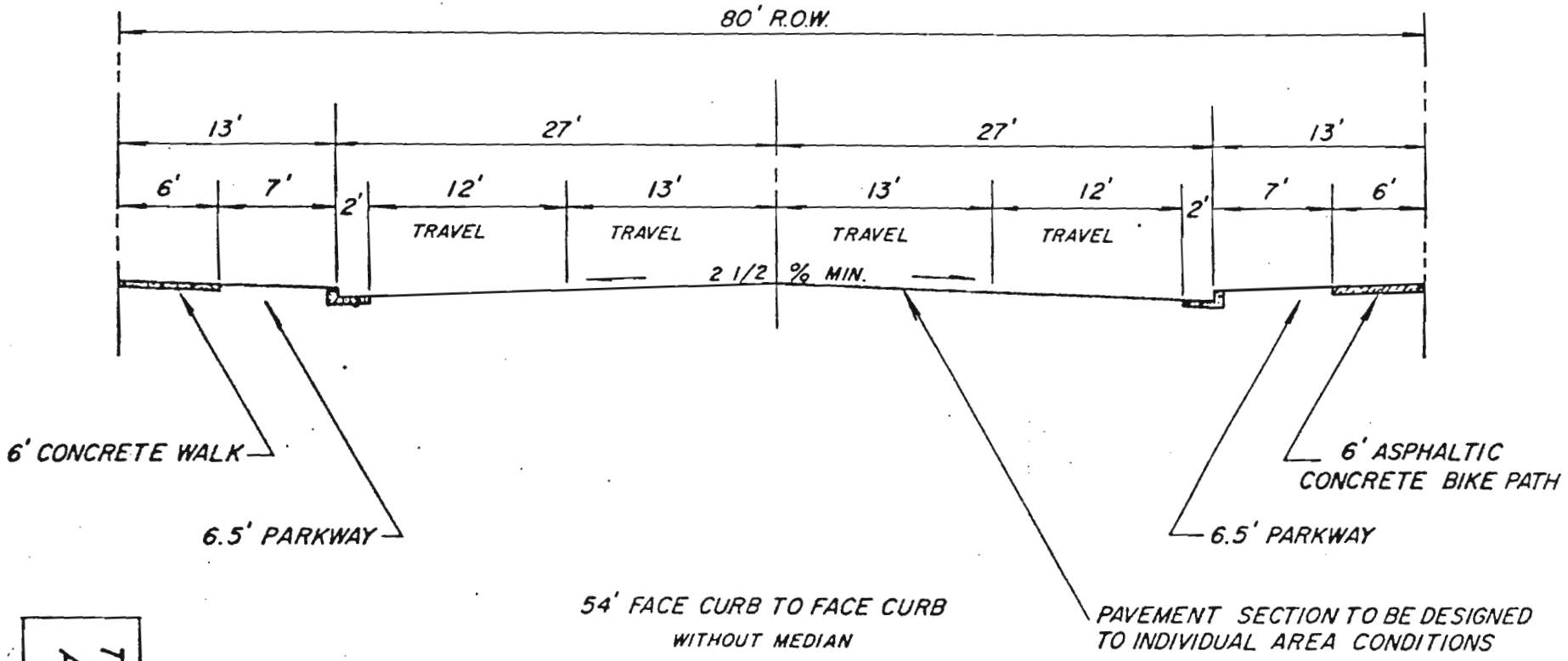


TYPICAL STREET SECTION
ARTERIAL - 100' R.O.W.

FIGURE 3-8(d)

THIS SECTION ALLOWS FOR FUTURE ADDITION OF ONE MORE BIKE PATH & WALK

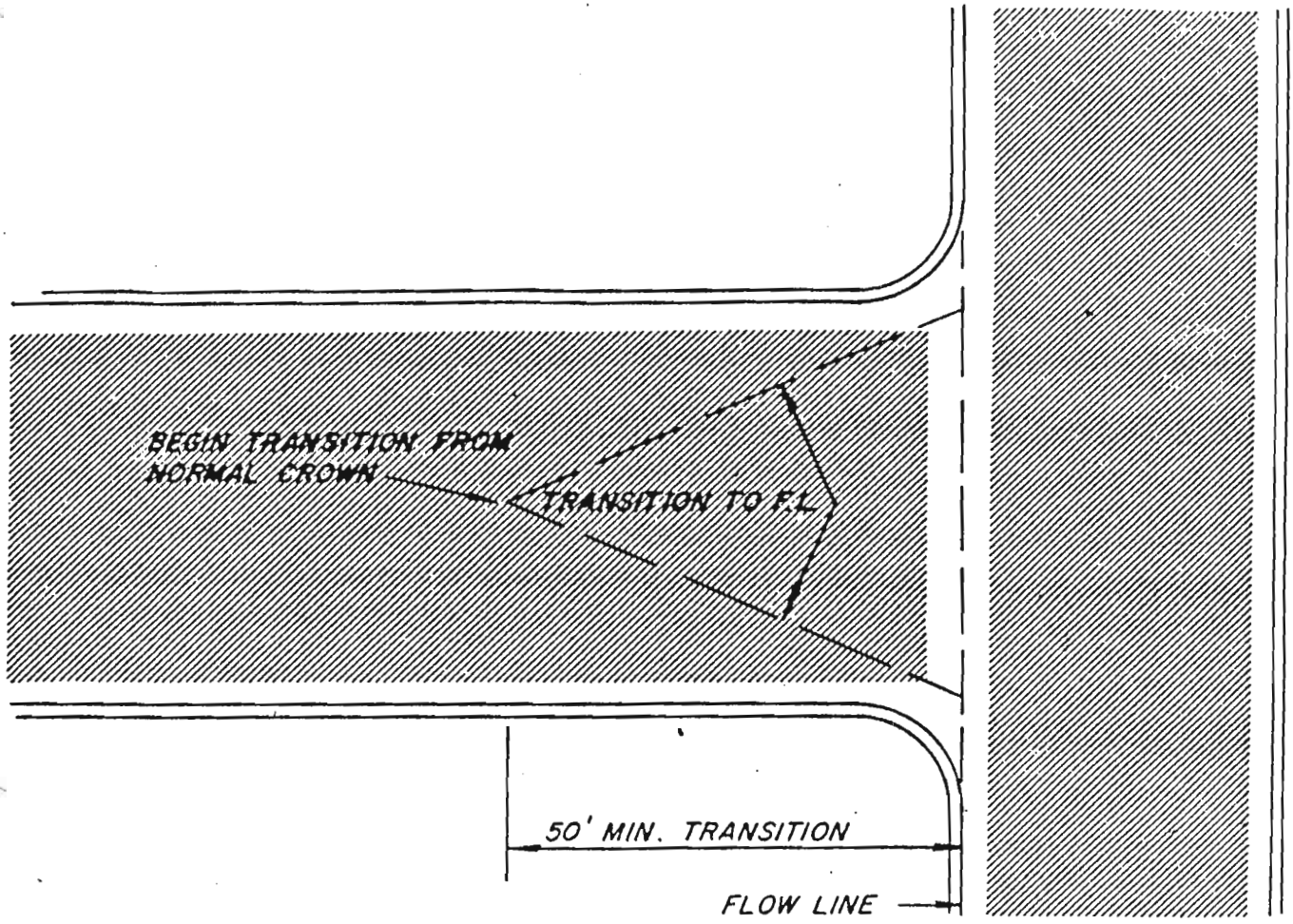
OR TWO ADDITIONAL TRAFFIC LANES

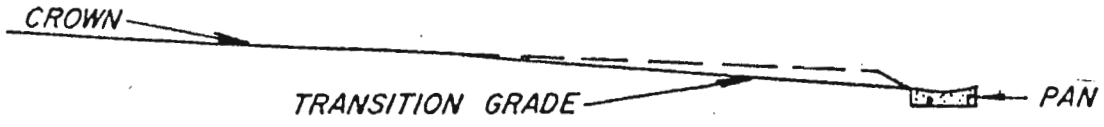


TYPICAL STREET SECTION
ARTERIAL - 80' R.O.W.

FIGURE 3-8(c)

SUGGESTED SECTION WHERE MEDIAN IS NOT REQUIRED





SECTION

FIGURE 3-9

STREET INTERSECTION GRADES DETAIL

SECTION 3
STREETS, CURB, GUTTER, SIDEWALK AND SIGNS

3.1 DESIGN CRITERIA

3.1.1 SUBMISSIONS:

1. Street, Curb Gutter, Sidewalk and Signs Public Improvements Plans: The public improvement plans shall describe the proposed streets and appurtenances thereto in adequate detail so as to serve as construction drawings as well as satisfying the requirements of this section.
2. Street Report: ; A street report shall be submitted with the final plat providing the date, calculations and test results used in the design of the pavement structures. The report will categorize each street as arterial, collector or local based on the definitions given in 3.l2.2. Paragraph 1.

3.1.2 METHOD: The design of pavement structures shall be based on the street classification and design criteria contained in this section.

1. Street Classification: Streets shall be classified according to the following general characteristics:
   a) Arterial Street:
      1) Traffic volumes of 10,000 vehicles per day when the land which the arterial serves is fully developed.
      2) A continuous length of several miles.
      3) Accommodates local and through traffic generally connecting with inter community routes.
      4) Traffic control provided by traffic signals.

   b) Collector Street:
      1) Traffic volumes exceeding 5000 vehicles per day when the land which the collector serves is fully developed.
      2) A continuous length of a mile or more.
      3) Accommodates local traffic from and onto local, other collector and arterial streets.
      4) Traffic control provided by traffic signals and stop signs.

   c) Local Street:
      1) Traffic volumes less than 5000 vehicles per day.
      2) A continuous length less than one mile.
      3) Accommodates local traffic from and onto individual lots and the collector and arterial street system.
      4) Traffic Control provided by stop and yield signs.

2. Flexible Pavements: The design of flexible pavements shall be based on the Colorado Department of Highways methodology, the Design Traffic Number (DTN) given in Table 3-1 and a design period of twenty (20) years. The DTN is defined as the estimated daily 18,000lbs., single axle load applications for the design lane during the design period.

   Minimum thickness of base and asphaltic pavement combinations shall be 2” ashpaltic concrete and 6” granular base.

TABLE 3-1
DESIGN TRAFFIC NUMBER

Zoning Classification	Street Classification		
	Local	Collector	Arterial
Residential	5	30	100
Commercial	30	50	200
Industrial	100	200	200

3. Rigid pavements: Street construction using alternate construction methods such as Deep Strength Asphalt or Portland Cement Concrete will be considered. Should the contractor/developer desire to consider one of these options, the option must be included in the pavement cross section design report.

3.1.3 CRITERIA:

1. Streets: Street shall have a logical relationship to topography and to the location of existing or platted streets in adjacent properties. Street, utility rights of way and public open spaces shall conform to approved plans for the extension of such public facilities.
   a. Minimum street width shall be as shown in Figure 3.8.
   b. Temporary dead-end streets, and cul de sac streets shall not be more than four hundred (400) feet in length. At the closed end the minimum turn around radius shall be fifty (50) feet. The closed end of the cul de sac street shall be at least one lot from the outside boundary line of any addit8ion, subdivision or tract or from any other street.
   c. Whenever possible, streets shall intersect at right angles.
   d. Street grades and vertical curve lengths are set forth in Table 3-2.

TABLE 3.2
MINIMUM STREET DESIGN CRITERIA

Street Classification	Maximum Grade	Minimum Grade	Min. vertical curve length
Arterial	5.0 percent	0.5 percent	100 ft.
Collector	6.0 percent	0.5 percent	*100 ft. or 50 ft. per percent Algebraic grade change
Local	10.0 percent	0.5 percent	*50 ft or 25 ft. per percent Algebraic grade change

*Where algebraic change is grades is less than one percent, vertical curves may be omitted.

   e. Street grades shall be flattened, whenever possible, to a grade of less than four (4) percent for a distance of at least 75 feet when approaching all intersections, and at the intersection a grade of three (3) percent shall be maximum.
   f. All utility service lines and main utility lines shall be installed prior to paving or any street.
   g. Minimum radii of horizontal curves at the street centerline shall be as follows:
      1) Arterial streets, five hundred (500) feet.
      2) Collector streets, two hundred (200) feet.
      3) Local streets, one hundred (100) feet.
   h. Between reverse curves, there shall be a tangent at least one hundred (100) feet in length.

2. Curb, Gutter, sidewalk, Driveway: all curbs, gutters, sidewalks, driveway approaches, and gutter pans shall be constructed with Portland Cement Concrete and shall conform to the Standards Design Drawings as listed in 3.5.

a. Sidewalk: Sidewalks shall have a minimum width four (4) feet and a minimum thickness of four (4) inches. An expansion joint shall be placed between the back of curb and the edge of the sidewalk when poured separately. (See Figure 3.2.)
Concrete sidewalks constructed in pedestrian easements located outside street ROW shall be a minimum of six (6) feet in width.
In commercial, industrial and business areas, storm water runoff from roof drains or downspouts shall not be allowed to drain over the sidewalk. Undersidewalk drains will be required to transport this runoff into the streets.

b. Driveway: In residential areas driveways shall not face onto arterial streets. The width of driveway approaches shall be as follows:
    1) Residential = 24 feet maximum
    2) Commercial = 35 feet maximum

When a new driveway approach is required to serve a single property, they shall be a minimum of ten (10) feet apart. No driveway approach shall be within thirty (30) feet of an intersection. Driveway approaches shall be constructed as follows:

1) Residential – 6" un-reinforced concrete, over 4" of compacted aggregate base, if base is required.

2) Commercial - 8" reinforced concrete, over 6" of compacted aggregate base, if base is required.

When a new driveway approach is to be installed through existing sidewalk, curb and gutter, the entire existing sidewalk curb and gutter, for the full length and width of the new driveway approach, shall be removed. The cut necessary to remove the existing sidewalk curb and gutter shall be made perpendicular to the curb and shall be made by saw cutting. Rough edges such as those made by jack hammering shall not be allowed.

c. Curb and Gutter: Vertical curb and gutter shall be used for all streets, except that gutter pans may be constructed in place of vertical curb and gutter in local streets of industrial zoned areas.
Cutter pans shall not cross arterial or collector streets. A transition shall be designed in local streets approaching the gutter pan crossing local streets. Handicapped ramps shall be placed in the sidewalk, curb and gutter at all street intersections.
Connection of new curb and gutter to existing curb and gutter shall be designed to provide a smooth transition of r flow in the gutter with a minimum of head loss. Expansion joint material shall be placed at the point of connection.
Minimum curb radius at intersections shall be as shown in Table 3-3.

TABLE 3-3
CURB RADIUS AT INTERSECTIONS

Street Classification	Local	Collector	Arterial
Local	15	20	20
Collector	20	20	20
Arterial	20	20	25

2. Signs:
   a. Traffic control Signs: Traffic control signs are categorized as regulatory, warning and guide signs. These signs shall be placed as follows:
      1) Regulatory Signs:
         Stop signs shall be placed to all traffic entering arterial streets not controlled by traffic signals. Where two arterials intersect, the stop sigh shall normally be posted on the street with the lesser flow of traffic.
         Stop signs shall be placed to all local street traffic entering collector streets not controlled by traffic signals. Yield signs may be used where visibility permits.
         SPEED LIMIT, PARKING PROHIBITION and other regulatory signs as required by the Town.
      2) Warning Signs:
         SCHOOL CROSSING signs shall be placed at all school crossings as designated by the school district.
         RAILROAD ADVANCE WRNING, DEAD END, PAVEMENT WIDTH TRANSITION and other warning signs shall be placed required by the Town.
      3) Guide Signs:
         BIKE ROUTE signs shall be placed to designate bike routes when a part of the street.
   b. Street Name Signs: Street name signs shall be placed on diagonally opposite corners at each intersection so that they will be on the far right-hand side of the intersection for traffic on the major street. Signs naming both streets shall be erected at each location. Local and collector streets in residentially zoned areas require only one street name sign posted at each intersection.
   c. Standardization of Signs: all traffic control signs and street name signs shall be designed to comply with the requirement of the Manual on Uniform Traffic Control devices prepared by the U.W. Department of Transportation.
   d. Installation:
      1) Posts and Mounting; Sign posts and their foundations and sign mountings shall be so constructed as to hold signs in a proper and permanent position, to resist swaying in the wind or displacement by vandalism.
         The post shall be constructed in two sections – a two (2) inch square stub section, three (3) feet long, which is driven into the ground; and a one and three-quarter (1 ¾) inch square post section which is inserted into the stub and bolted.
      2) Height: Signs shall be mounted at a height of seven (7) feet, measured from the bottom of the sign to the top of curb. The height to the bottom of a secondary sign mounted below another sign shall be six (6) feet fro m the top of curb. Where a traffic control sign is mounted on the same post with a street name sign, it shall be placed below the street name sign, with the bottom of the traffic control sign seven (7) feet from the top of curb.

3.2 SPECIFICATIONS

3.2.1 SCOPE: The work covered by these specifications concerns the furnishing of all labor, equipment, and materials and performing all operations necessary for the construction of streets, curb and gutter, sidewalks, driveway approaches, gutter pans and signs in accordance with these specifications and the Standard Design Drawings in 3.5.

3.2.2 GENERAL REQUIREMENTS: Streets, curb, gutter, sidewalks driveway approaches, gutter pans and signs shall be constructed in accordance direction of a professional engineer and approved by the Town Engineer.
All standard specifications made a portion of these specifications by reference shall be the latest edition and revision thereof.

3.2.3 MATERIALS:

1. Subgrade: Subgrade material shall be all well graded mixture of sound mineral aggregate particles containing a sufficient quantity of binder material to secure a firm, stable foundation when placed and compacted o the roadway, meeting the following gradation.

Standard Sieve Size	Percent by Weight Passing
Equivalent to 2/3 the depth of sub base Course layer expressed in inches.	100
#10	80
#200	5-15

2. Soil Sterilization Chemical Agents: Chemical soil sterilization agents used in the construction of public improvements shall be:
    d. A non selective, pre and post emergent, soil toxic herbicide.
    e. Active for 1 year after completion of the project.
    f. Miscible or soluble in water; and
    g. Non toxic to humans when used under conditions designated by the manufacturer.

   Approved soil sterilants, rates of application and usage derived from manufacturer's recommendations and "Colorado Weed Control Handbook" shall be those acceptable to the Colorado Department of Highways as described in Section 217-71 of their Standard Specifications.

3. Aggregate Base Course: A suitable aggregate base course, compacted to a uniform minimum density 95% of the Standard Proctor is required under all curb and gutter, sidewalks and driveways if the subgrade alone cannot provide sufficient support to prevent shifting, cracking or settling of finished concrete. Aggregate base courses for streets shall be placed in the location and in the amounts as indicated on the approved public improvement plans.
   All materials used in aggregate base courses shall meet all applicable portions of Sections 304 and 703.03 of the "Standard Specifications for Road and Bridge Construction", State of Colorado, Department of Highways.

   The design of the pavement section will allow for the full range of classes of aggregate base course. The top course of aggregate base shall be limited to Class 6 meeting the following gradation:

Standard Sieve Size	Percent by Weight Passing
¾"	100
#4	30-65
#8	25-55
#200	3-12

LL not greater than 30, PI not greater than 6.

4. Portland Cement Concrete: All concrete used in the construction of curb, gutter, sidewalk, and driveways shall have a minimum compressive strength of 3,000 psi in 28 days.
   The minimum cement content shall be six(6) sacks of cement per cubic yard. Type II cement shall be used, unless soils testing information indicated that another type of cement is required. If Fly Ash is to be utilized in the concrete mix, prior approval must be given by the Town Engineer and a concrete mix design, prepared by a testing laboratory, must be submitted for approval. Fly Ash must meet the requirements of Class "C: DSTM C-618. Air entrainment in the concrete mixtures shall be provided at the rate of 3% to 6% air content by volume. The proportions of all materials to be used in the concrete mix shall produce a workable mix having a maximum slump of four (4) inches. No water shall be added to the concrete at the job site without approval of the Town Inspector.

5. Steel Reinforcing: Steel reinforcing shall be either Deformed Billet-Steel Wire Fabric.

Type	Test Method	Requirements
Deformed Billet Steel Bars	ASTM A 615	Grade 40 or 60
Welded Steel Wire Fabric	ASTM A 185	

   Reinforcing steel shall be protected at all times from damage when placed in the work, the reinforcing steel shall be free from dirt, detrimental scale, paint oil, or any other foreign substance which could reduce the bonding.

6. Bituminous Prime Coat: If needed, this work shall consist of preparing and treating an existing surface with bituminous material, and blotter material as required, in accordance with these specifications and in reasonably close conformity with the lines shown on the approved construction plans.
   The type and grade of bituminous material to be used for the prime coat shall meet all of the requirements of Section 407 and Section 702 of the "Standard Specifications for Road and Bridge Construction", State of Colorado, Department of Highways.
   Blotter material, if required, shall meet the following gradation requirements.

BLOTTER MATERIAL

Standard Sieve Size	Percent By Weight Passing
½"	100
No. 4	90-100
No. 16	30-75

Blotter material shall be used in the amounts necessary to absorb excess bituminous material. Excess blotter material shall be removed prior to the placement of the subsequent courses. Blotter material shall be free from all organic matter, lumps or balls of dirt and any other foreign matter which could cause adverse effects on the final product.

7. Asphaltic Concrete: Aggregate for bituminous surfacing shall conform to the requirements of the Colorado Department of Highways Section 703.04-71 grading E.
   Commercial mineral filler, if required, shall meet the requirement of AASHTO M 17.
   All bituminous materials shall conform to the requirements of the Colorado Department of Highway Specifications Sections 407-71, 409-71 and 702-71. Asphaltic cement AC-10, 85-100 penetration bitumen incorporated o the specified percent as determined by the CDH job mix for the pit supplying the material (5-6 ½%).
   The bitumen content for the job-mix formula shall not vary from the single unit value specified by 0.5%±. The job-mix formula shall be submitted to the Town Engineer for approval. Once approval is obtained that job-mix formula will remain valid until such time a s changes in the basic contents occur. These changes could be aggregate source, type of aggregate used, or a change in the bitumen material. If such change occurs, then the revised job-mix formula will have to be resubmitted for approval.
   Samples of the completed mix may be taken at the project site for testing as required by the Town Engineer.
   Should eth results of the additional testing indicate that the bituminous mixture placed is in deviation form the approved job-mix formula, then the mixture could be subject to rejection. Should any of the mixture be rejected, it shall be immediately removed and replaced with an acceptable mixture. The rejection or acceptance of the mixture is place will be made by the Town Engineer or is authorized representative.

8. Appurtenances:
   a. Manhole Riser brick: Brick for the upper portions of manholes shall be Grade MS or MM conforming to ASTM Designation C32-69.
   b. Pre-cast Reinforced Manhole Cones and Sections: Cones and sections shall conform to ASTSM Designation C478-70 except as modified by the Town's Standard Detail Drawing.
   c. Manhole Steps: Steps shall be non-skid COMCO #12653B or approved equal, non-staggered, 15" C-C being an aluminum magnesium silicide alloy conforming to Federal Specifications QQ-A-200/8.
   d. Concrete Mortar: Mortar shall be composed of 1 part Type II Portland cement to 2 parts clean snad, thoroughly mixed dry and then having only that amount of water added and missed to form a paste of workable consistency. Re-tempered mortar is not acceptable.
   e. Manhole Rings and Covers. Rings and covers shall be gray cast iron conforming to ASTM Designation A-48 free of defects. COMCO #C-1161 or approved equal, having machined metal bearing surfaces.

3.3 CONSTRUCTION

3.3.1 GENERAL REQUIREMENTS: section 7, General Specifications, shall be followed except as modified in 3.3.2.

3.3.2 SPECIFIC REQUIREMENTS: The following specific requirements shall apply in the construction of the streets, curb gutter, sidewalk and signs:

1. Clearing and Grubbing: The Contractor shall remove from the limits of the ROW or easement all obstructions or obstacles, the presence of which can be determined by visual inspection, such as sod, trees, shrubs, fences, walls and other obstructions called for on the plans.
   Removal of shrubs, stumps and trees shall include sufficient length of the root system to insure that the vegetation will not continue to grow. Obstructions, structures, etc., shall be removed to a depth of 3 feet below proposed finish grade. Removal of stumps, roots trees, shrubs, obstructions, etc., shall be disposed of by the Contractor.
   Trees schedule to remain shall be carefully protected from damage during construction operations. Any damage due to the Contractor's operations shall be replaced as approved by the Town, all at the Contractor's expense.

2. Excavation: All excavation will be unclassified and shall consist of the excavation of all material of whatever character encountered within the limits of the project; ;including, but not limited to, surface boulders, muck, rock, concrete foundations, slabs stripping, excavation for ditches or channels, borrow etc. Excavation operations shall be conducted so that material outside the limits of slopes will not be disturbed and to provide adequate drainage at all times. Materials shall not be wasted without permission of the Town Inspector. Insofar as practicable, all suitable materials shall be used in the formation of embankments and backfilling. Materials that are considered unsuitable or surplus by the Town Inspector shall be disposed of by the Contractor at his expense.

3. Subgrade: Areas to received embankment and the top of cut areas shall first be stripped of all vegetation, organic material, all other materials that are unsuitable for use in embankment, and disposed of by the Contractor at his expense.
   Within the limits of the embankment and cut area, the subgrade shall be scarified to a depth of six (6) inches and the moisture content increased or reduced as necessary to bring the moisture with ± 2% of optimum moisture content and compacted to the relative compaction specified below.
   Maximum dry densities of all soil types encountered or to be used will be determined in accordance with AASHO T-99 or T-180 Methods C-D. the percent of relative compaction required will be equal to or greater than minimum values as hereinafter shown for the various classes of soil and type of compaction.

Soil Classification (AASHO M-145)	Standard Proctor AASHO T-99 Minimum Relative Compaction	Modified Proctor AASHTO T-180 Minimum Relative Compaction
A-1	100	95
A-3	100	95
A-2-4	100	95
A-2-5	100	95
All others	95	90

   Compacted subgrade ready to receive sub base material shall conform to the lines, grades and cross-section called for on the plans. Subgrade is to be established by survey.
   No curb, gutter, sidewalk, cross-pan, base course or Asphaltic concrete is to be placed in soft, spongy or frozen subgrade.
   The town Inspector shall inspect and approve the subgrade before any aggregate base course material or concrete can be placed.

4. Soil Sterilization: Subgrade areas to be sterilized, such as parking lots, bituminous sidewalks, etc., shall have all surface vegetation removed within 3 days prior to treating the soil. The soil sterilizer shall then be applied at the rates and in accordance with the manufacturer's recommendation at a temperature of 70' or higher.
   The Contractor shall comply with all Colorado statutes, ordinance, or codes pertaining to the use of application of fungicide, insecticide, herbicides, or other agricultural chemicals.
   The Contractor will be held responsible for any damage to plant growth outside the designated treatment area where such damage is attributable to carelessness or improper application of the soil sterilizer.
   Care shall be exercised to prevent powder, spray, or vapor which may damage gardens, shrubs, or trees in the vicinity of the areas being treated. Soil sterilizers shall not be used where they may contaminate water used for irrigation or drinking purposes.
5. Aggregate Base Course: The aggregate base course material shall be uniformly deposited on the approved subgrade by means of the hauling vehicle with or without spreading devices. Aggregate will be distributed over the surface to the depth specified on the approved construction plans.
   After the aggregate has been deposited, it shall be spread and finished of the required cross-section by means of a self propelled pneumatic-tired motor grader.
   The base course material and water may be mixed at the plant in a mixer. Water shall be added during the mixing operation by moisture content for compacting. After mixing to the extent that the product has a uniform homogeneous appearance, the material may be transported o the job while it contains the proper moisture content and may be placed on the roadbed by means of an approved self-propelled aggregate spreader. If the material dried appreciably prior to final compacting, additional water shall be added by means of a water tank to assist in compaction and to prevent raveling.
   Water may be applied prior to and during all blading and processing operations to moisten the material sufficiently to prevent segregation of the fine and course particles. Water shall be applied during the compaction and maintenance stages in sufficient amounts to assist in compaction and prevent reveling.
   Compaction shall immediately follow the spreading operation. Where the required thickness is six (6) inches or less, the base course may be spread and compacted in one layer. However, if vibrating compaction equipment is used, and the requirement for density is complied with, the compacted thickness of any one layer may be increased to eight (8) inches. Aggregate bases, place d on median strip areas, shoulder Areas, and at locations which are inaccessible to the spreading equipment, may be spread in one or more layers by any means to obtain the specified results. Each layer of material shall be compacted to mot less than ninety-five (95) percent relative compaction of the Standard Proctor.
   It is to be expected that a loss of density in the upper portion of the material may occur due to the elements, or for other reasons. Recompaction to the specified density may be required prior to placement of any subsequent course.
   Tolerance of the finished surface: When a twelve (12) foot straight edge is laid in any direction, the finished surface shall not deviate at any point more than 0.04 feet.

6. Forms: Slip form construction or stationary forms may be used. Metal or wood forms shall have a depth equal to or greater than the concrete section being placed. Feasible forms shall have sufficient strength to support the placement of the concrete. Forms shall remain in place for a minimum of four (4) hours. Face plate forms for curb and gutter shall be removed as soon as practicable in order to

allow for finishing of the curb face and top. Concrete curb placed by the extrusion process will be an acceptable alternative.

7. Placing Concrete: Prior to the placement of concrete, the contractor shall obtain approval of the installation of form work from the Town Inspector. Any forms or base course material which has been disturbed shall be corrected prior to the replacement of any concrete forms shall be oiled and the base moistened prior to the placement of any concrete.
   After the forms and base course are approved by the Town Inspector, the concrete can be placed. The concrete shall be placed as uniformly as possible to minimize the amount of movement and spreading. During the placing operation, the concrete shall be spaded and/or vibrated with suitable equipment to insure no formation of voids or honeycomb. Care shall be taken during the vibrating operation to vibrate only enough to insure proper consolidation of the concrete and to bring to the surface a continuous film of mortar. Vibrating shall stop prior to segregation of the concrete. Vibrators shall not be used to move or spread the concrete.
   a) Cold Weather Concreting: Concrete shall not be placed unless the air temperature is 35' F and increasing. Placement of concrete shall cease when the decreasing temperature falls below 40' F. When placing concrete in cold weather, the temperature of the mix shall not be less than 50' F nor more than 90' F, at the time of placing. Aggregates and water shall not be heated above 150'F. Calcium chloride or other set acceleration admixtures may be used only if authorized by the Town Inspector. Before placing concrete, all ice, snow, or frost shall be removed from the forms, reinforcing steel and the base. In no case shall concrete be placed directly against frozen ground or ground containing frost.
      After placing concrete, the temperature of the concrete shall be maintained above 50' F for at least four (4) days. Provide sufficient protection by the placement of loose dry straw or insulated curing blankets. The protection shall be such that it will keep moisture from coming into direct contact with the newly placed concrete. With the use of high early strength cement, the concrete temperature shall be maintained above 50'F for at least two (2) days. Any concrete placed under these conditions, which is found to be damaged by freezing shall be determined to be unacceptable land shall be removed and replaced as directed by the Town Inspector.
   b) Hot Weather Concreting: Concrete shall not be placed if the temperature of the plastic concrete cannot be maintained at 90'F or lower. Water reducer retarders may be used to retard the rate of hydration and time of set only if approved by the Town Inspector. Accelerators will not be employed in hot weather concreting.
   c) Joints: Joints in concrete curb, gutter, sidewalk and gutter pans shall be designated as expansion joints and weakened plan joints.
      1) Expansion Joints: Expansion joints shall be constructed in curbs, gutters, sidewalks and gutter pans as shown on the Standard Drawings. Such joist shall be filled with pre-molded joint filler and shall conform to the requirements of ASHTO M 213, or ASTM D 1751, Fiber Type.
         One-half inch joints shall be constructed in curb and gutter at the ends of all returns and also at locations matching those expansion joints placed in sidewalks. Expansion joints shall be placed in sidewalks at all curb returns, utility poles, fire hydrants, and street lights. Expansion joint material shall be placed the full depth of the concrete.
         Expansion joints in sidewalks shall be placed at a maximum of three hundred (300) foot intervals. Excess expansion joint material protruding above the finish surface of the concrete shall be trimmed flush with the concrete surface.

2) Weakened Plane Joints: Weakened plane joints shall be placed in curb and gutter and sidewalks at a maximum spacing of ten (10) feet. Weakened plane joints shall be a minimum of three-fourths (3/4) inch deep, one-eighth (1/8) inch wide with rounded edges.

d. Finishing Concrete: Finishing of concrete shall be completed as specified herein for the type of work being performed.
   1) Curbs: The front forms may be stripped as soon as the concrete has sufficiently set. The face and the top of the curb shall be carefully trowelled to a smooth and even finish. Both of the face edges of the gutter shall be finished with a ¾" radius rounding. The trowelled surface shall be finished with a fine hair broom applied parallel with the line of work. The edge of the concrete at all expansion joints shall be rounded to a ¼" radius.
   2) Sidewalks: The forms for sidewalk shall be set to place a slope of ¼" per foot, sloping from the back of the walk down toward the top of cur. Following placing, the concrete shall be screeded to the required grade, tamped to consolidate the concrete and to bring a thin layer of mortar to the surface. The surface shall be slanted to a smooth, flat, uniform surface. The concrete shall then be edged at all headers, given a preliminary trowelling and provided with weakened plane joints. Edges at expansion joints shall be rounded to a radius of ½ inch.
      Sidewalk shall be trowelled to a smooth and even surface. All formed edges shall be rounded. Preliminary trowelling may be done with a long handled trowel, but the finish trowellng shall be done by hand trowel. After final trowelling, sidewalks shall be given a fine hair broom finish. Walks shall be remarked as necessary after final finish application.
      All forms and headers shall remain in place for a minimum of sixteen (16) hours.

   3) Gutters and Gutter Pans: After the concrete has been thoroughly tamped in such a manner to force the larger aggregate into the concrete and bring to the surface sufficient free mortar for finishing, the surface shall be worked to a true and even grade by means of a float, trowelled with a long-handled trowel and wood float finished. All for ms and headers shall remain in place for a minimum of twenty-four (24) hours. NO heavy traffic shall be allowed over the concrete until design strength has been met.

e. Curing: Freshly placed concrete shall be cured by protecting it against moisture loss, rapid temperature change, rain, flowing water, and mechanical injury for a period of not less than seven (7) days after placeme4nt. It shall be the contractor's responsibility to protect the concrete from traffic and the elements. Proper curing procedures shall be the responsibility of the cont4ractor. Any one of the following methods may be used:
   1) Water Method: The concrete shall be kept continuously wet by the application of water for a minimum of seven (7) days after the concrete has been place. The entire surface of the concrete shall be kept damp by the application of water in the form of a fine mist. The moisture from the nozzle shall not be applied directly onto the surface and shall not be allowed to accumulate in sufficient quantity to cause a flow or a washing of the concrete surface.
   2) Curing Compound Method: The entire surface of the concrete shall be sprayed uniformly with a curing compound. The application of the curing compound shall be as per the manufacturer's recommendations. This method shall not be used until all

finishing is complete. All traffic on the concrete surface shall be kept to an absolute minimum until the curing time is complete.

3) Waterproof Membrane Method: The membrane shall be formed into sheets of such width as to provide a complete cover over the entire surface. All joints in the sheets shall be securely cemented together I such a manner as to provide a waterproof joint. Overlay of sheets shall be a minimum of eighteen (18) inches. The sheets shall be securely weighted down which will insure proper protection to the concrete.

8. Steel Reinforcing: Steel reinforcing shall be placed I the locations and in the quantities as shown in the Standard Design Drawings and public improvement plans.
   Bent bar reinforcement shall be code bent to the shape shown on the plans.
   All bar reinforcement shall be accurately placed in the positions shown on the plans or Standard Drawings, and securely fastened so that no movement occurs during the placement of the concrete. When the spacing of bars exceeds one (1) foot in either direction, all intersections shall be tied. Distance from forms and ground shall be maintained by means of block, hangers or chairs.
   The placement of all reinforcing shall be furnished in the full lengths indicated on the plans or Standard Drawings. Splicing of bars, except where shown on approved plans, will not be permitted without approval of the Town Inspector.
   IN lapped splices, the bars shall be placed in contact and wired together. The length of lap for deformed bars shall be at least twenty four (24) bar diameters for Grade 40 and at least thirty six (36) bar diameters for Grade 60, with a minimum splice lap of twelve (12) inches. Welded wire mesh reinforcement shall be lapped at least one (1) mesh opening wide with all ends and edges securely fastened.

9. Bituminous Prime Coat: The contractor shall provide equipment for heating and applying the bituminous prime coat material and the blotter material. The equipment shall be capable of applying the materials in a uniform manner at the specified rates of application.
   Bituminous material shall not be applied when the weather conditions are such that the application will not perform the desired function. No bituminous material shall be applied to any surface which is wet, frozen, or in any other conditions which the Town Inspector considers unsuitable. In any case no bituminous material shall be applied when the atmospheric air temperature is below 50'F.
   The surface upon which the bituminous prime coat is to be placed shall conform to the established lines and grades, shall be smooth and uniform and shall be compacted to this required density. If the required density deteriorates between the time the gravel course was compacted originally and the time the prime coat is placed, for any reason whatsoever, the surface shall be re-compacted to the required density of the expense of the contractor.
   Bituminous material shall be applied to the width of the section to be primed by means of a pressure distributor in a uniform, continuous spread. When traffic is maintained, not more than one half (1/2) of the width of the section shall be treated in one application. Care shall be taken that the application of bituminous material at the junctions of spreads is not in excess of the specified amount. Excess bituminous material shall be squeegeed from the surface area. Skipped areas of deficiencies shall be corrected.
   When traffic is maintained, one way traffic shall be permitted on the untreated portion of the roadbed. As soon as the bituminous material has been absorbed by the surface and will bot pick

up, traffic shall be transferred to the treated portion and the remaining width of the section shall be primed. Application rate shall be between .20 and .30 gallon per square yard of surface area. The temperature requirement pertaining to the application of liquid asphalts and Asphaltic emulsions shall conform to the requirement of the following table.

SPRAYING TEMPERATURE OF LIQUID ASPHALTS

Grade & Type RC,mc & SC	Minimum		Maximum	
	F'	C'	F'	C'
70	120	49	180	82
250	165	74	220	104
800	200	93	255	124
30000	235	113	290	143

The primed surface shall be maintained by removing all loose sand prior to placing any pavement or surfacing material thereon. Immediately in advance of placing asphalt concrete or asphalt concrete base additional prime coat shall be applied as directed to areas where the prime coat has been damaged, and loose or extraneous material shall be removed.

10. Asphaltic Concrete Pavements: Asphaltic concrete material, from a stationary plant, meeting Colorado Department of Highways job placed and compacted in layers on a prepared subgrade surface in conformity with the lines, grades and typical cross section shown on the public improvement plans.
The storage yard, stationary mixing plant, distributor, hauling equipment, laydown pavers, and rollers shall conform to the requirements of the Colorado Department of Highways Specification Section 401.08-71 thru 401.11-71.
Plant mix Asphaltic concrete shall be placed only on properly constructed and accepted subgrades that are free from water, snow, or ice. The bituminous mixture shall have a minimum ambient temperature of 280' F in the truck at point of delivery and shall be placed within the following air temperature limitations:

Compacted Thickness	Minimum Placement Air Temperature
<1"	60'F
1" – 2 ½"	50'F
>2 ½"	40'F

Prior to the placement of Asphaltic concrete, the surface of existing pavement or base shall be brought to uniform grade and cross section as directed.
Asphaltic concrete shall be placed by means of bituminous paves, spread and struck off to the grade and elevation established. The longitudinal joint in the finish layer shall overlap any sub-layer by 6 inches and shall be as follows:

a) For two lane streets – at the center line of the pavement and at the outside edge of the traveled lanes.
b) For streets of more than 2 lanes – at the lane lines and at the outside edges of the travel lanes.

On areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impracticable, the mixture shall be spread, raked, and compacted by hand tools. For such areas, the mixture shall be dumped, spread, and screeded to give the required compacted thickness.

Where Asphaltic concrete is placed along a curb, sufficient material shall be deposited so as to provide a compacted thickness 1/8 inch above the lip of the gutter pan.

Following spreading of Asphaltic concrete and adjusting irregularities, the bituminous mix shall be thoroughly and uniformly compacted by rolling. On lifts of 3 inches or more, breakdown rolling shall follow immediately after the paving machine using rubber tired rollers, free of recapped tires, followed by steel wheel rolling until all roller marks are eliminated and a minimum density of 93 percent of the theoretical maximum density for the job mix has been obtained.

Unless otherwise directed, rolling shall begin at the sides and proceed longitudinally parallel to the street centerline, each trip overlapping one half the roller width, gradually each trip overlapping one half the roller width, gradually progressing to the crown of the street. When abutting a previously placed lane, the longitudinal joint should be rolled first, followed by the standard rolling procedures.

Any displacement occurring as a result of the reversing of the direction of a roller, or other cause, shall be corrected at once by the use of rakes and addition of fresh mixture when required.

Adhesion of the mixture to the rollers shall be prevented. Wheels shall be kept properly moistened with water or water mixed with a small quantity of detergent. Excess liquid will not be permitted.

Rollers shall not pass over the unprotected end of a freshly laid mixture unless authorized by the Town Inspector. Transverses joist shall be formed by cutting back on the previous run to expose the full depth of the course. When directed by the Town Inspector, a coat of bituminous material (RC) shall be used on contact surfaces of all joints just before additional mixture is laced against the previously rolled material.

The variation between any two contacts with the surface shall not exceed 3/16 inch in 10 feet. Humps or depressions exceeding the specified tolerance shall be corrected by removing defective work and replacing it with new material as directed.

11. Other pavements: Deep strength Asphaltic concrete and Portland cement concrete pavements may be allowed. Design plans and specifications for these alternate pavements must be submitted to the Town Engineer for approval.

3.4 TESTING

3.4.1 COMPACTION TESTS: Compaction tests to verify specified compaction of subgrade and aggregate base course in all streets shall be performed on an average of one test for every two hundred lineal feet of street. Tests shall be performed by and independent testing laboratory in the presence of the Town Inspector.

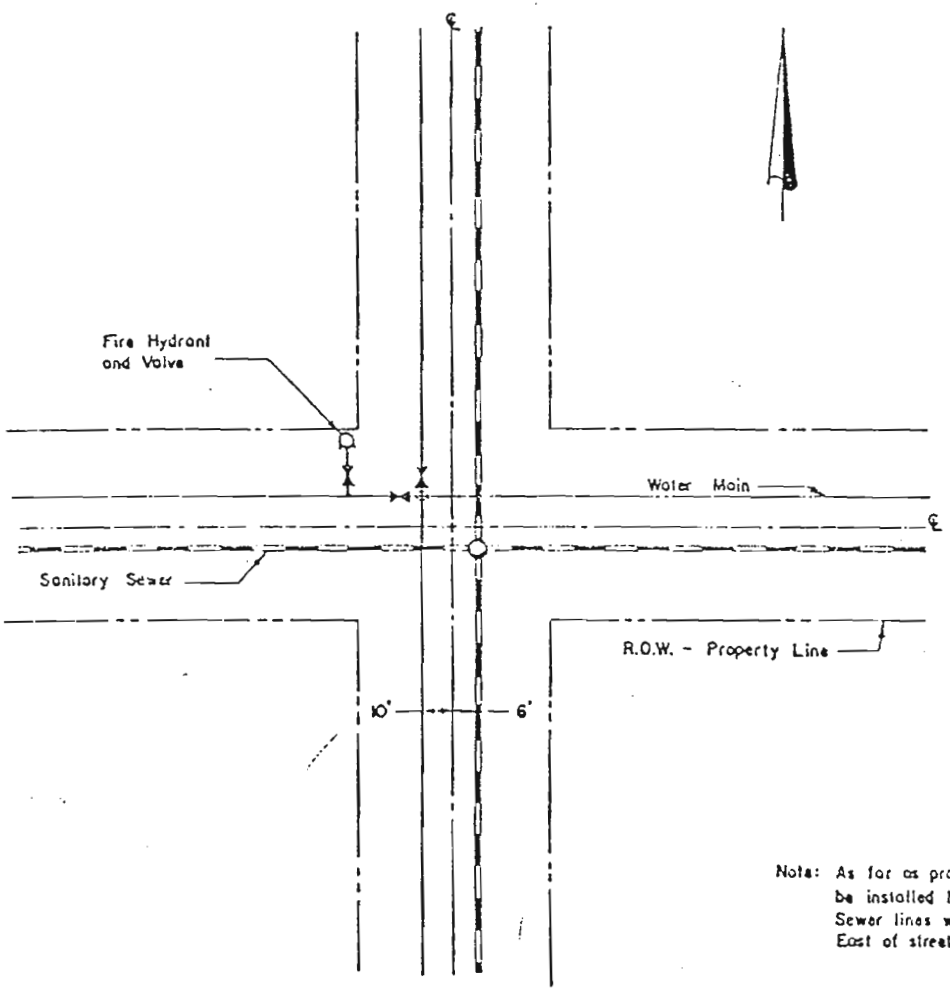
3.4.2 CONCRETE TESTS: Concrete used in constructing public improvements specified I this section and throughout the remaining sections of the is manual shall be tested as follows:

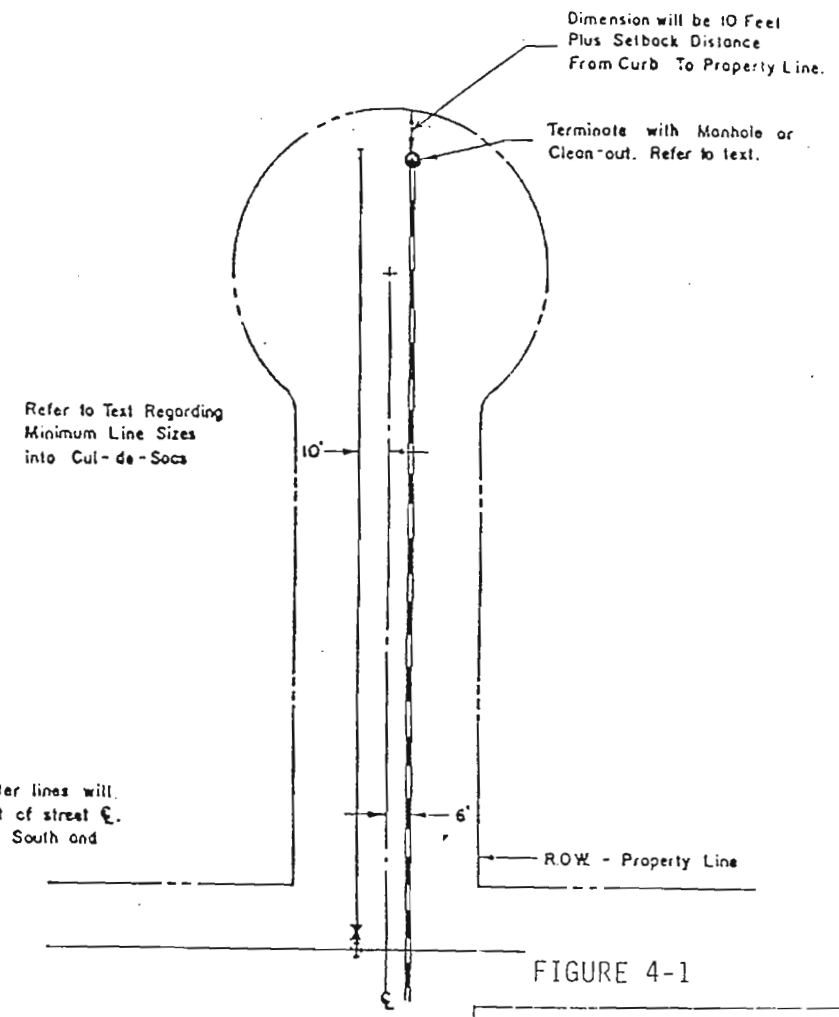
Test	ASTM Specifications
Slump	C 143
Air Content	C 173
Test Cylinders	C 31 or C 513
Core Samples	C 42

Slump shall be measured by the Contractor each time test cylinders are to be made and at any other time upon request of the Town Inspector. The slump shall not be more than 5 inches or as specified in this manual. Air content shall be measured each time test cylinders are to be made. Test cylinders shall be made by an independent testing laboratory in sets of four. One cylinder shall be field cured and broken at 7 days. Three cylinders shall be laboratory cured and broken at 28 days. If the 28 day cylinders to not meet the specified minimum compressive strength then a representative number of concrete cores may be taken from the structure to determine if the in place concrete meets the specified strength. The deficient concrete shall be replaced at the Developer's expense. A set of test cylinders may be taken for each 50 CY of concrete placed or fraction thereof as required by the Town Inspector.

3.5 STANDARD DESIGN DRAWINGS

Figure 3-1	Concrete Curb and Gutter
Figure 3-2	Concrete Sidewalk
Figure 3-3	Residential Driveway Approach
Figure 3-4	Commercial Driveway Approach
Figure 3-5	Concrete Gutter Pans
Figure 3-6	Handicapped Ramp
Figure 3-7	Monolithic Concrete Sidewalk and Curb & Gutter
Figure 3-8	Typical Street Cross Sections
Figure 3-9	Street Intersection Grades Detail





Note: As far as practible, all water lines will be installed North and West of street ℄. Sewer lines will be installed South and East of street ℄.

FIGURE 4-1

MAIN LOCATIONS IN THRU STREETS & CUL-DE-SACS

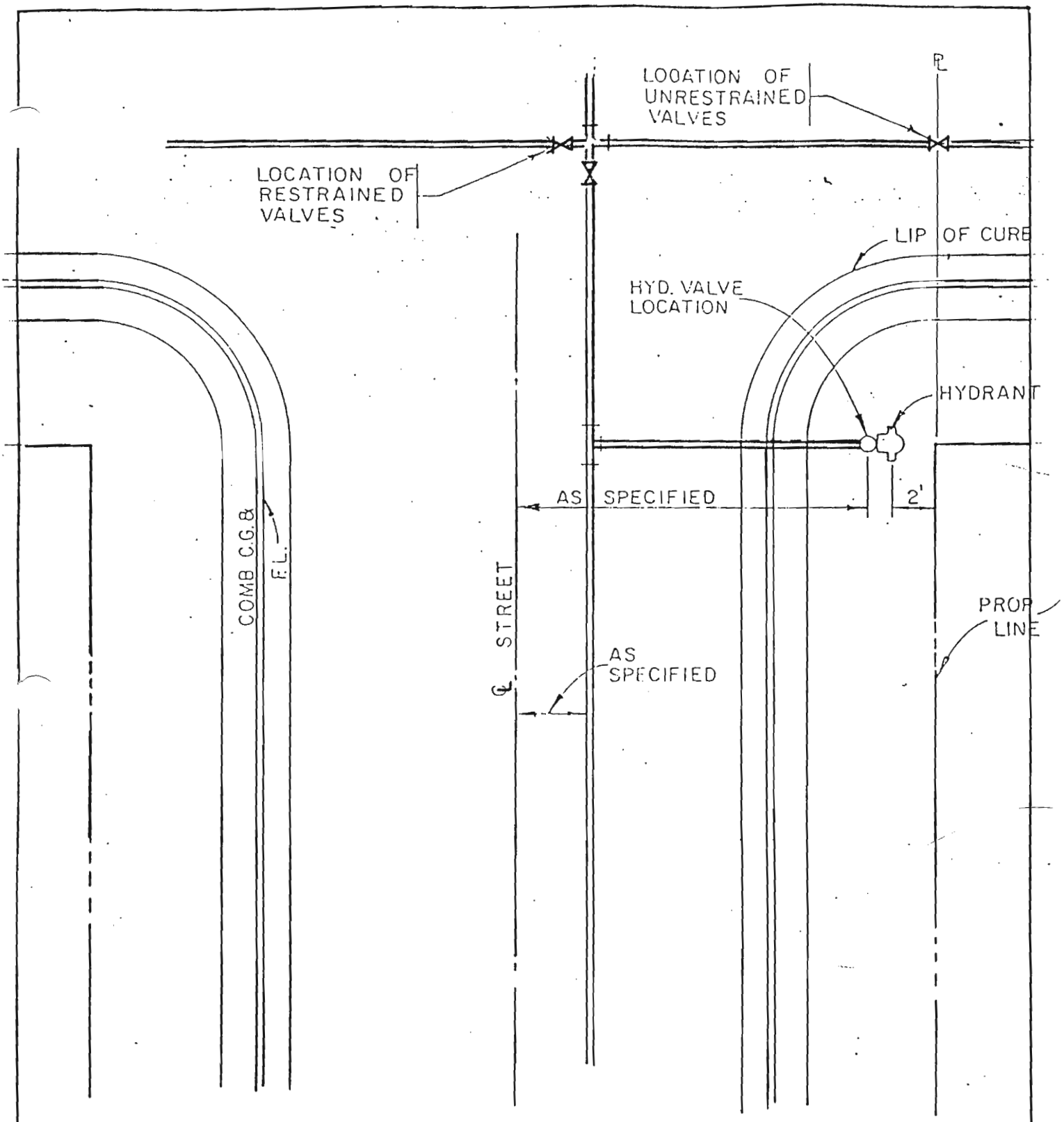
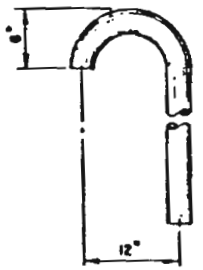
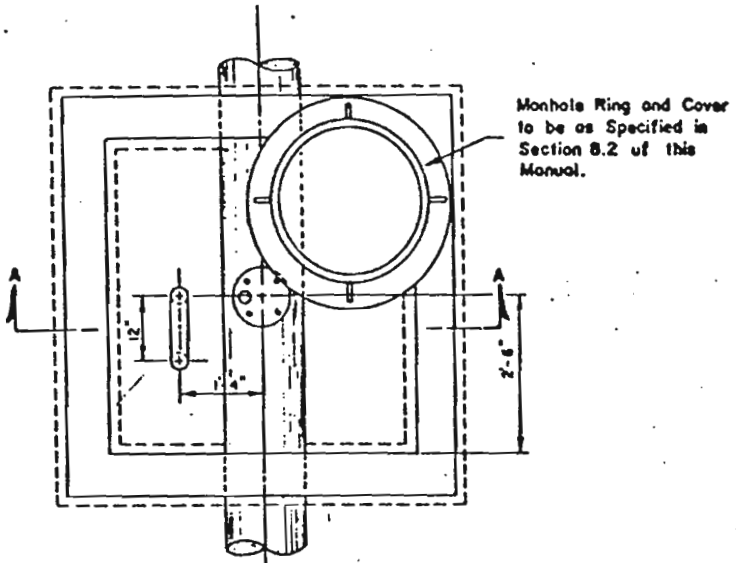


FIGURE 4-2

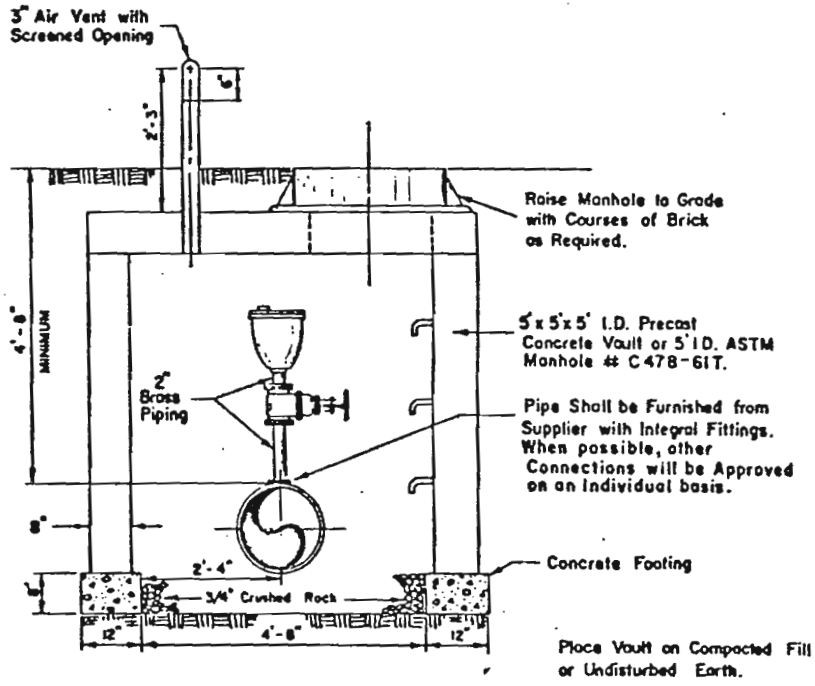
LOCATION OF FIRE HYDRANTS AND VALVES



VENT PIPE DETAIL



PLAN VIEW

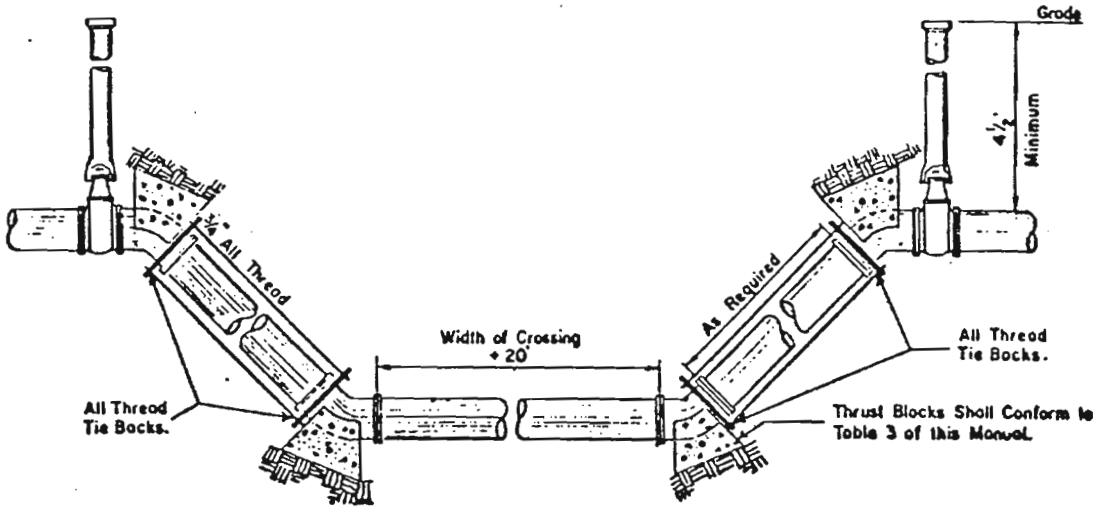


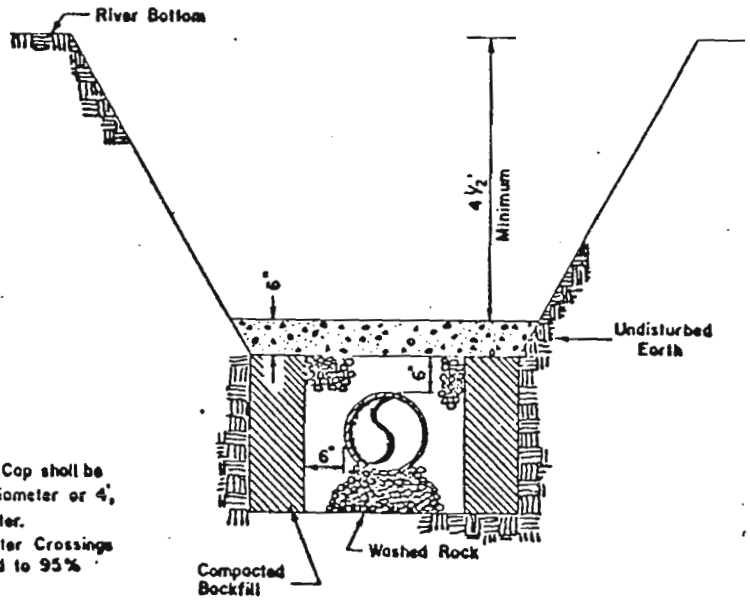
SECTION A-A

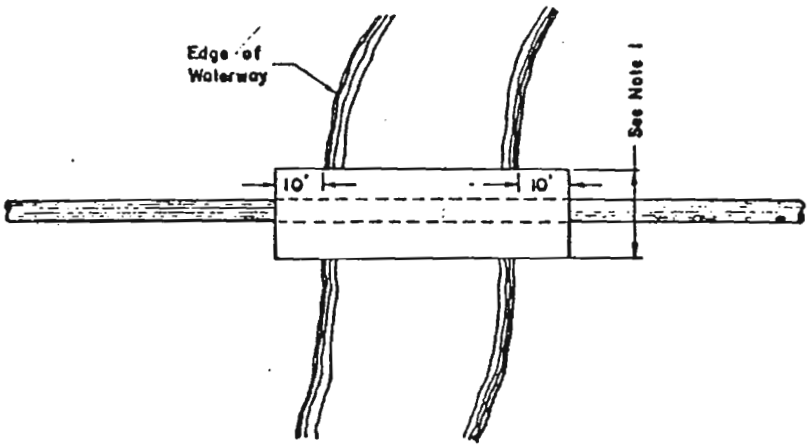
Contractor shall furnish all piping, valves, fittings, vault, etc. for a complete installation.

FIGURE 4-3

AIR RELIEF VALVE DETAILS



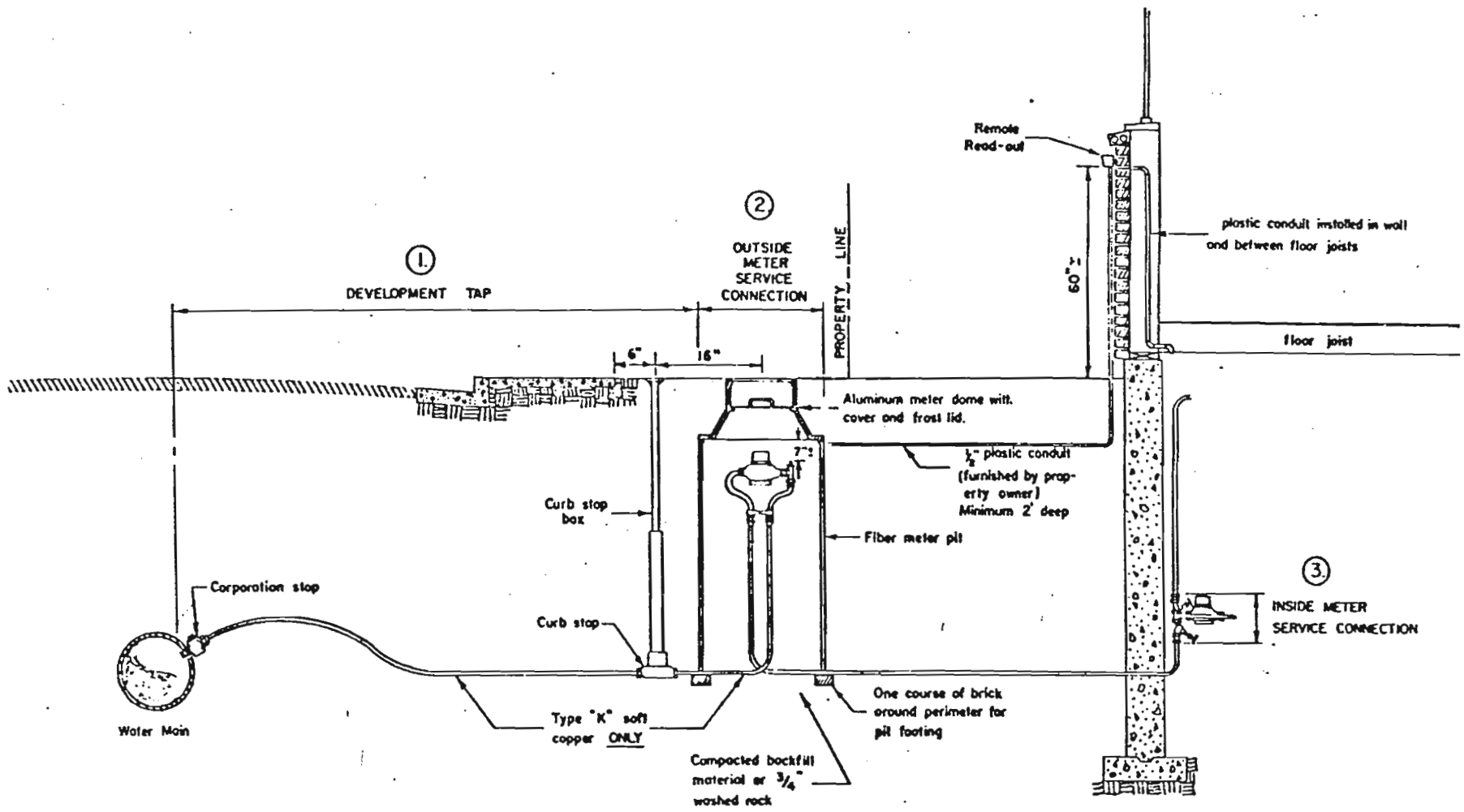




Notes:
1. Width of Concrete Cap shall be 3 Times the Pipe Diameter or 4', Whichever is Greater.
2. All Backfill for Water Crossings shall be Compacted to 95% Maximum Density.
3. All Required Shoring shall Conform to Table 2 of this Manual.
4. All Crossings shall be Valved at both ends.

FIGURE 4-4

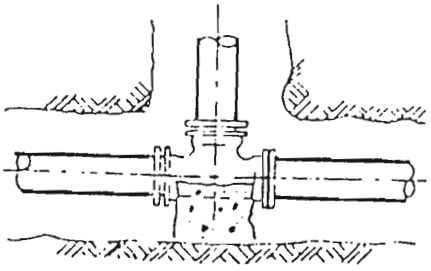
WATERCOURSE CROSSING DETAILS



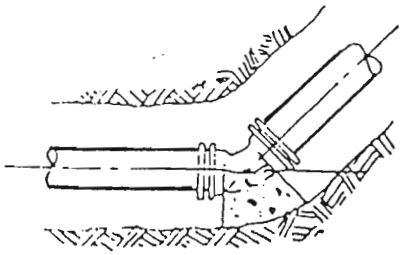
1. For existing buildings when no Building Permit is required, meter location shall be determined by the Water Dept. prior to issuance of Meter Service Connection Order.
2. No consumptive uses will be permitted prior to water being metered, i.e. sprinkling systems, laundry facilities, etc.
3. Inside Meter Service Connections may be installed in either the basement or on the first level of the building. Under no circumstances will meters be installed in crawl spaces.
4. Connection wire between meter and read-out shall be installed with a minimum of 3 extra feet of wire at the meter to facilitate connection of the meter. Wire shall be continuous strand with no splices.

FIGURE 4-5

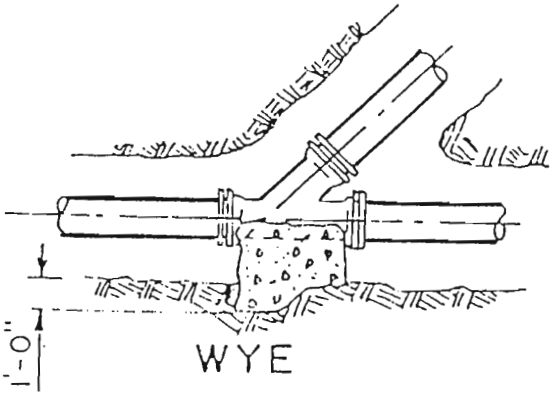
WATER TAP DIFFERENTIATION AND METER LOCATIONS



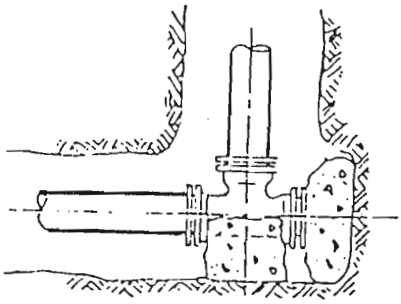
TEE



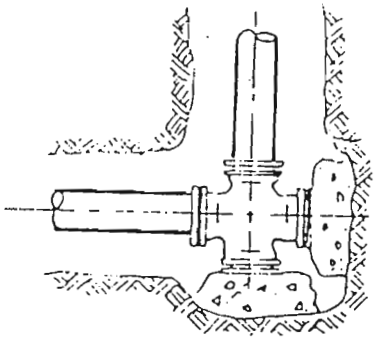
BEND-HORIZONTAL OR
BOTTOM OF VERTICAL



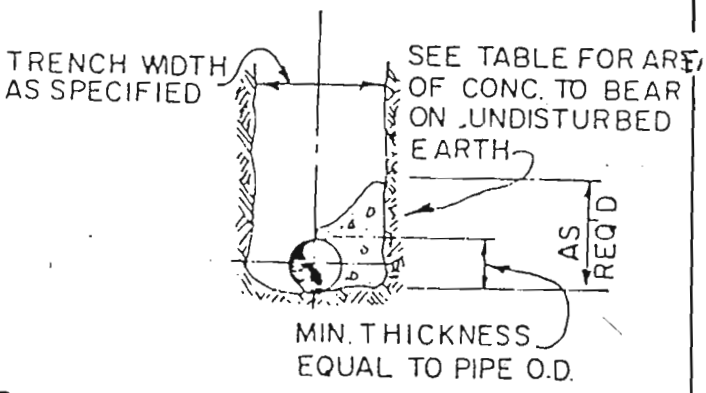
WYE



TEE W/DEAD END ON RUN

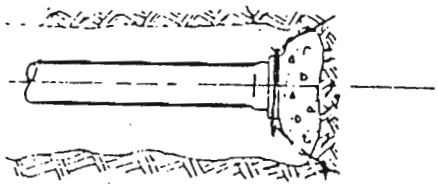


CROSS W/ DEAD END BRANCHES

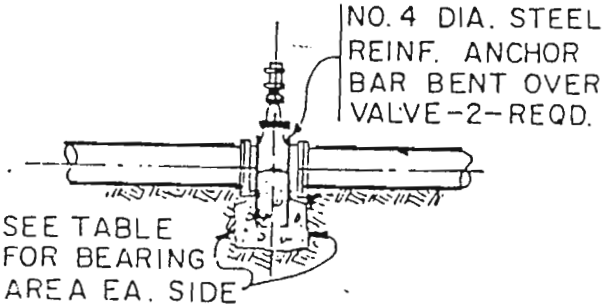


SECTION
(TYPICAL)

PLUG OR LINE CAP



DEAD END



VALVE
(GATE OR BUTTERFLY)

FIGURE 4-6(a)

THRUST BLOCKS

TABLE OF BEARING AREAS IN SQ. FT. FOR CONCRETE THRUST BLOCKING

FOR 100 P.S.I. INTERNAL STATIC PRESSURE AND 1000 LBS. PER SQ. FT. SOIL BEARING CAPACITY.

SIZE	BENDS				TEES	GATE VALVES	DEAD ENDS	CROSS W/ 1 BRANCH PLUGGED	CROSS 2 BRANCH PLUGGED
	90°	45°	22 1/2°	11 1/4°					
3	1.0	0.6	0.3	0	0.7	0.5	0.7	0.7	0.7
4	1.8	1.0	0.5	0	1.3	0.5	1.3	1.3	1.3
6	4.0	2.2	1.1	0	2.8	0.7	2.8	2.8	2.8
8	7.1	3.8	2.0	1.0	5.0	2.4	5.0	5.0	5.0
10	11.1	6.0	3.0	1.5	7.8	4.5	7.8	7.8	7.8
12	16.0	8.6	4.4	2.2	11.3	7.3	11.3	11.3	11.3
14	21.7	11.8	6.0	3.0	15.4	11.0	15.4	15.4	15.4
15	25.0	13.5	7.0	3.5	17.6	SPECIAL DESIGN	17.6	17.6	17.6
16	28.4	15.3	8.0	4.0	20.0		20.0	20.0	20.0
18	36.0	19.4	10.0	5.0	25.4		25.4	25.4	25.4
20	44.2	24.0	12.2	6.1	31.4		31.4	31.4	31.4
21	49.0	26.5	13.5	6.8	34.6		34.6	34.6	34.6
22	54.0	29.0	14.8	7.4	38.0		38.0	38.0	38.0
24	64.0	34.5	17.7	8.8	45.0		45.0	45.0	45.0
30	100.0	54.0	27.6	13.8	71.0		71.0	71.0	71.0
36	144.0	78.0	40.0	20.0	102.0		102.0	102.0	102.0

SIZE IS BRANCH SIZE.

AREAS GIVEN IN TABLE ARE BASED UPON AN INTERNAL STATIC PRESSURE OF 100 P.S.I. AND A SOIL BEARING CAPACITY OF 1000 LBS. PER SQ. FT. BEARING AREAS FOR ANY PRESSURE AND SOIL BEARING CAPACITY MAY BE OBTAINED BY MULTIPLYING THE TABULATED VALUES BY A CORRECTION FACTOR "F".

$$F = \frac{\text{ACTUAL SPECIFIED TEST PRESSURE IN HUNDREDS OF LBS/SQ. IN.}}{\text{ACTUAL SOIL BEARING CAPACITY IN THOUSANDS OF LBS.}}$$

FIGURE 4-6(b)

THRUST BLOCKS

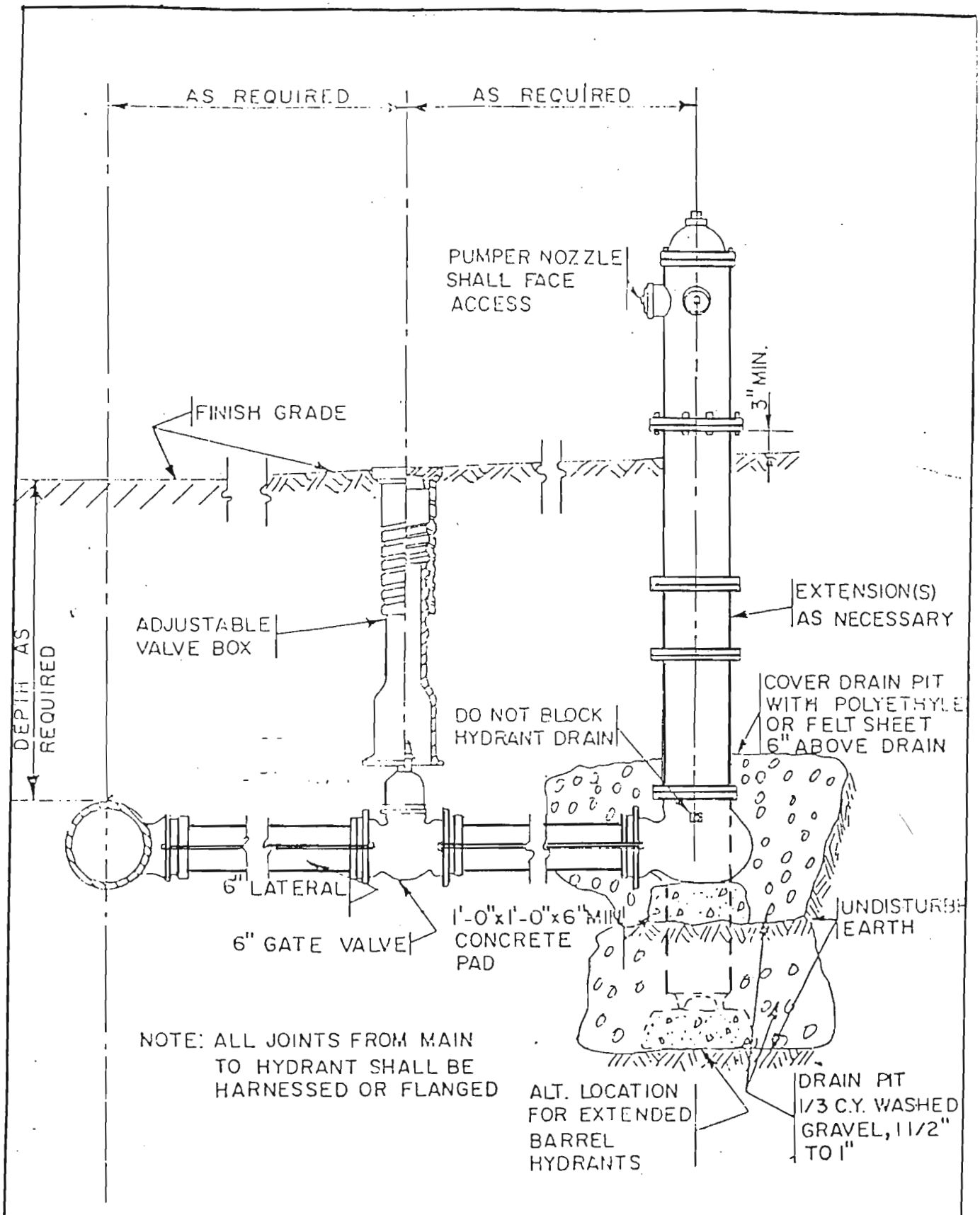


FIGURE 4-7

FIRE HYDRANT ASSEMBLY

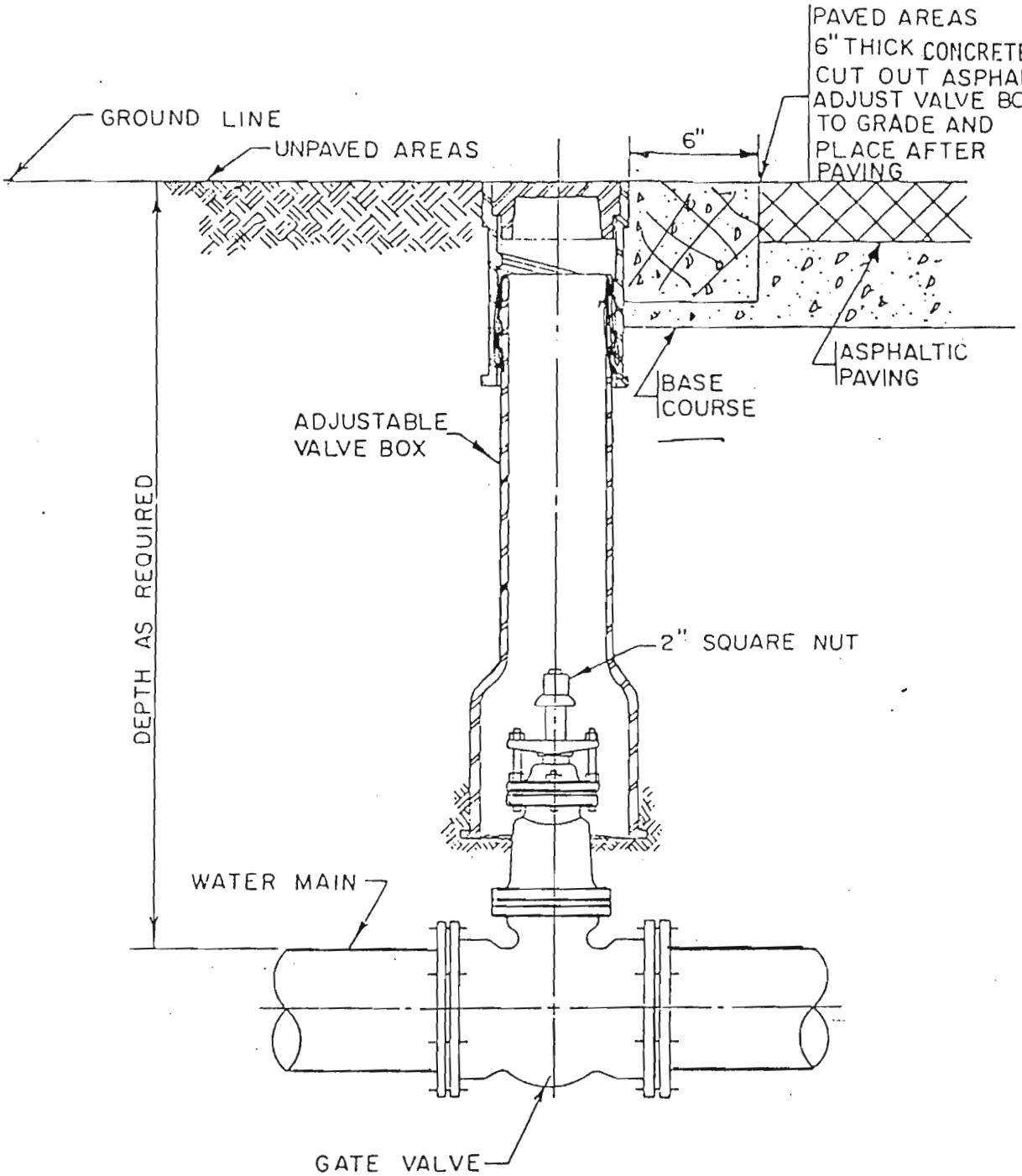
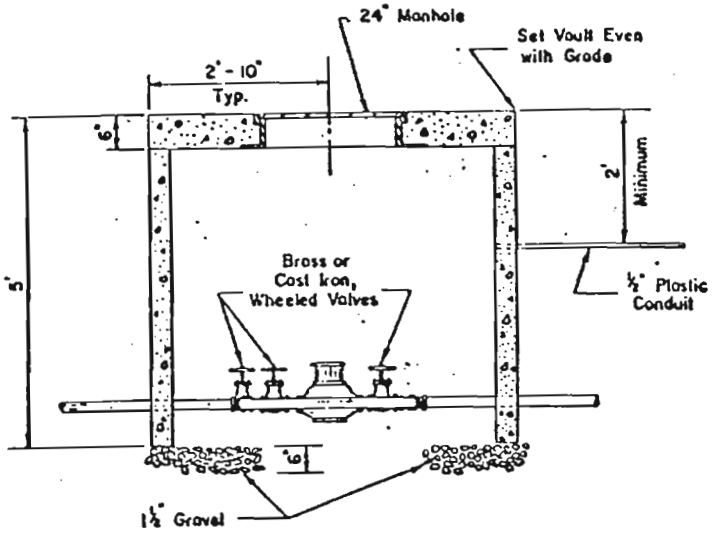
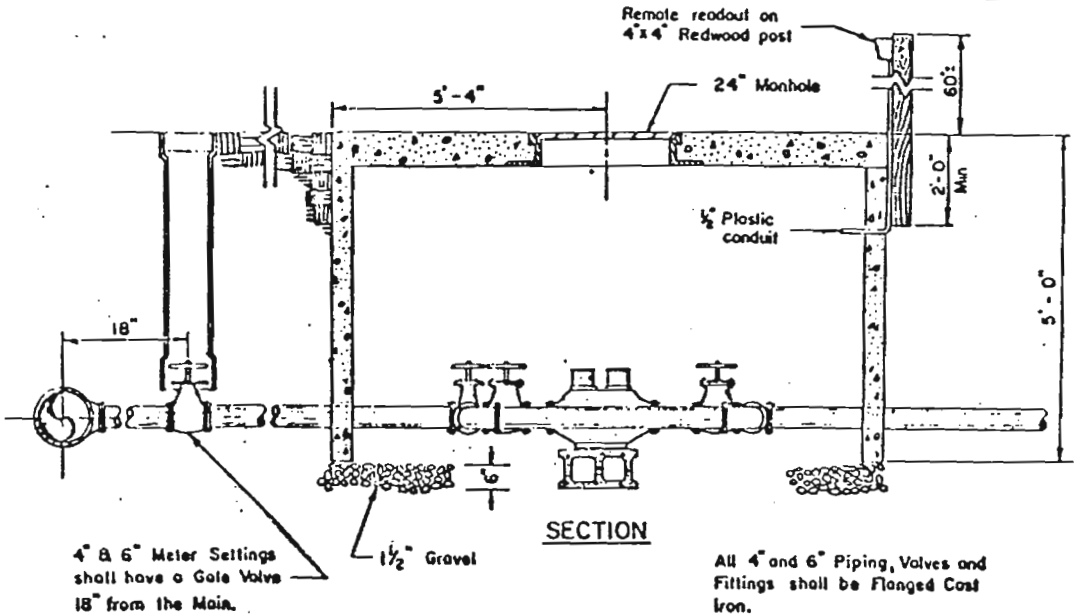


FIGURE 4-8

GATE VALVE AND VALVE BOX
DETAILS



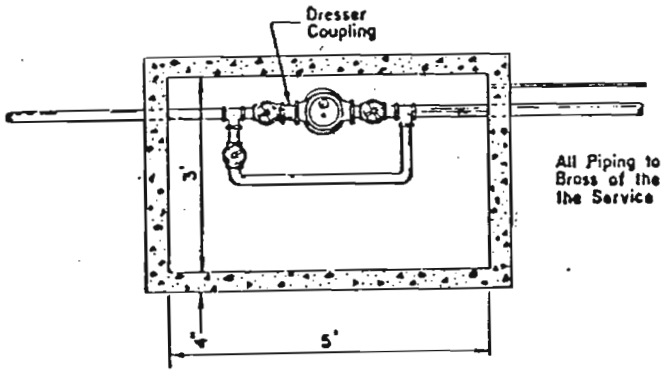
SECTION



SECTION

4" & 6" Meter Settings shall have a Gate Valve 18" from the Main.

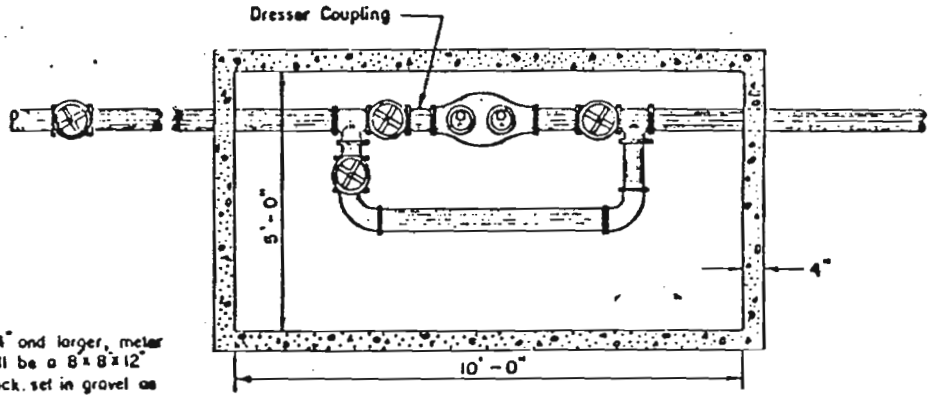
All 4" and 6" Piping, Valves and Fittings shall be Flanged Cast Iron.



PLAN

All Piping to be Copper or Brass of the Same Size as the Service Line.

1½" & 2" METER and VAULT DETAILS



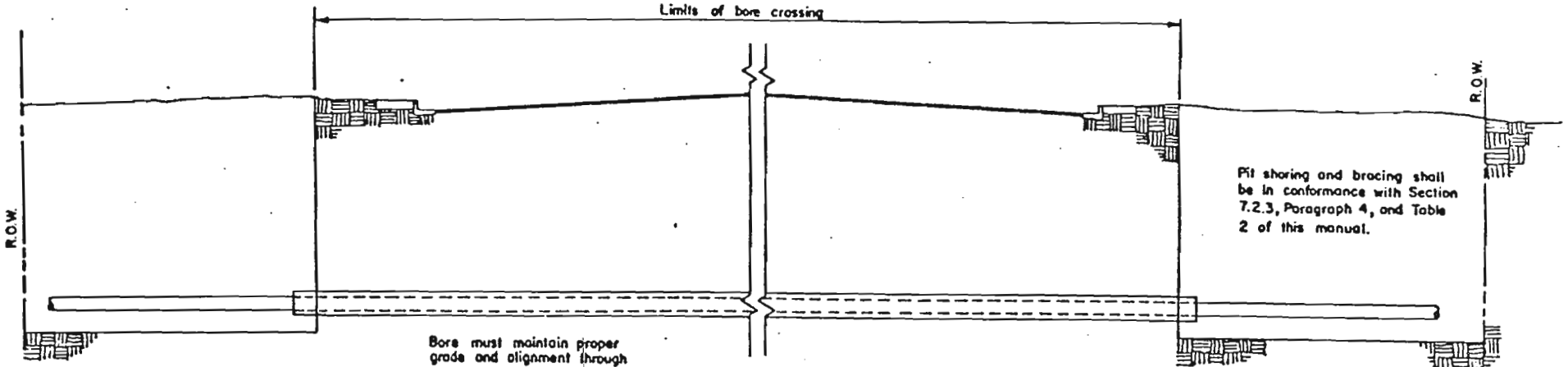
PLAN

For meters 4" and larger, meter support shall be a 8"x8"x12" concrete block, set in gravel as shown. Vault cover may be sectional (3 piece) to facilitate installation and removal.

4" & 6" METER and VAULT DETAILS

FIGURE 4-9

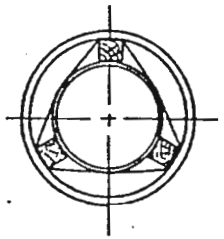
METER SETTINGS for TAPS 1½" and LARGER



PROFILE

No Scale

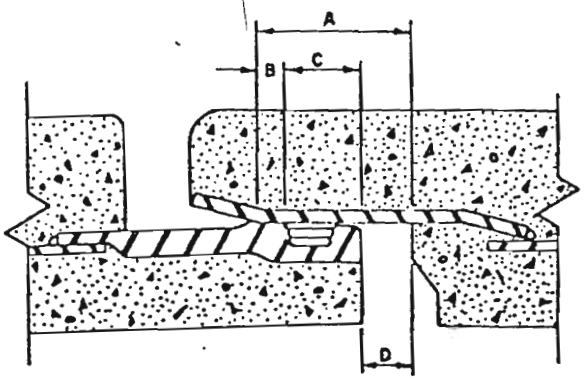
Redwood skids of the proper dimension shall be banded to carrier pipe prior to insertion into bore casing. Voids shall filled with blown-in sand.



DETAIL

FIGURE 4-10

BORE CROSSING DETAILS



A = Depth of straight portion of bell

B = Minimum reserve extensibility

C = Sealing and gasket retention space

D = Maximum joint opening

Pipe Size	A	B		C	D	
		Layout	Installation		Layout	Installation
16-30	2-1/4	9/16	7/16	1-1/8	9/16	11/16
36	2-3/8	5/8	1/2	1-1/8	5/8	3/4
42	2-3/4	7/8	3/4	1-1/8	3/4	7/8
42	3-1/8	7/8	3/4	1-1/8	1-1/8	1-1/4
48	2-7/8	7/8	3/4	1-1/8	7/8	1
48	3-1/8	7/8	3/4	1-1/8	1-1/8	1-1/4
54	2-7/8	7/8	3/4	1-1/4	3/4	7/8
60	3	7/8	3/4	1-1/4	7/8	1

All dimensions are in inches.

FIGURE 4-11

MAXIMUM JOINT OPENING
for STEEL and RUBBER
PIPE JOINTS

SECTION 4
WATER DISTRIBUTION SYSTEM

4.1 DESIGN CRITERIA

4.1.1 SUBMISSIONS:

1. Water Distribution system Public Improvements Plans: The public improvement plans shall describe the proposed water distribution system in adequate detail so as to serve as construction drawings as well as satisfying the requirements of this section.
2. Water Distribution system Report: A water distribution system report shall be submitted with the final plat describing the basis for the design of the water distribution system and shall include but is not limited to :
   a. Soil conditions with resistivety test results along the proposed water line location.
   b. Anticipated water consumption requirements including peak daily demand.
   c. Fire flow requirements according to Insurance Services Office requirements.
   d. Anticipated residual pressure within the subdivision on peak hour demand.

4.1.2. METHOD: The design of the water distribution system shall be based on standard design practices and design criteria contained in this section.

4.1.3 CRITERIA: The design of the water distribution system shall be based on the following:

1. Flow: Design peak daily residential per capita demand shall be 400 gallons per day. Peak daily industrial demand must be approved by the Town Engineer. Peak minute residential demand shall be taken to be 15 gpm. Residential areas require 1500 gpm for fire flow. In industrial and commercial areas, a fire flow of 3500 gpm shall be made available for the area.
   All pipes shall be designed to have a maximum velocity of 10 feet per second.

2. Pressure: all areas shall be designed to have a maximum static head of 250 feet (108 psi) and a minimum static head of 100 feet (43 psi). distribution systems shall also be designed to maintain a 20 psi residual pressure during required fire flow and a 30 psi residential residual during peak residential flows. Pressure zones shall conform to existing town of Lyons zones as approved by the Town Engineer.

3. Pipe size: The minimum pipe size shall be determined as follows:
   a. Minimum pipe size for residential shall be six (6) inch diameter, except where smaller diameter pipe is approved for areas of low demand.
   b. Minimum pipe size for commercial and multiple family areas (higher density than duplex) shall be eight (8) inch diameter.

4. Distribution system layout:
   a. Dead ends shall be minimized by looping all mains, when possible.
   b. Water lines shall be located in the streets as shown in Figure 4-1. Other utilities shall not be installed within ten feet of any existing town water line.
   c. Water lines into cul-de-sacs shall extend so that the maximum distance from the water line to the curb at the closed end of the cul de sac shall not exceed ten (10) feet.

d. Water mains shall be located 10 feet to the north or east of the street center-line. See figure 4-1.

5. Valves will be located as follows:
    a. At all street intersections so that each block may be isolated.
    b. At each entrance into a cul-de-sac.
    c. For each fire hydrant.
    d. In all cases the line valves shall not have more than a 600-foot separation.

6. Fire Hydrants: Fire hydrant locations shall be as follows:
    a. Fire hydrants shall be connected to looped water lines, whenever possible.
    b. Fire hydrants shall be connected to six (6) inch diameter lines and larger.
    c. Single family and duplex residential developments shall have fire hydrants spaced so that no structure shall be more than 300 feet from the hydrant as measured via the street. Hydrants shall not be more than 600 feet apart.
    d. Fire hydrants in cul de sacs over 300 feet in length shall be on an eight (8) inch minimum water main.
    e. Multiple family (higher density than duplex) developments shall have fire hydrants spaced so that no structure shall be more than 200 feet from a fire hydrant as measured via the street. Hydrants shall not be more than 400 feet apart.
    f. Commercial and Industrial developments shall have fire hydrants spaced so that no structure shall be more than 175 feet from a hydrant as measured via the street. Fire hydrants shall not be more than 350 feet apart.
    g. Fire Hydrants shall be located at intersections as far as practicable as shown in Figure 4-2.

7. Air Relief Valves: On mains larger than ten (10) inch diameter, air relief valves shall be provided at all high points. The air relief valve shall be placed in a vault with easy access and sufficient working space. (See figure 4-3 for valve and vault specifications.)

8. Surface Water Crossings: Prior to preparations of construction drawings, surface water crossings shall be discussed with town Engineer. In general, the following requirements shall be met:
    a. Above Water Crossings: The pipe shall be adequately supported, protected from damage from freezing and accessible for repair or replacement.
    b. Under Water Crossings: The pipe shall be bedded in ¾ inch washed rock six (6) inches or more surrounding the main with a six (6) inch thick concrete cap on top. (See Figure 4-4 for details.)

9. Cover: All distribution mains shall have a minimum of 4 ½ feet and a maximum of six (6) feet of cover from finished grade to the top of the pipe. Prior to the installation of any water main, the street shall be at subgrade elevation.

10. Service Connections: Water service lines shall be located so as to take the shortest, most direct path (preferably perpendicular to the water main) from the water main to

the house. When possible, the water service lines shall be located five (5) feet from the lot centerline, on the high side of the lot, and a minimum of ten (10) feet on the horizontal plane from the sanitary sewer service line.
The point where the water service line crosses under the curb shall be marked. This point shall be indicated by chiseling a symbol "V" on the curb. All water service lines shall have a minimum of 4 ½ feet of cover to finished grade. Water service lines are not allowed to cross property other than the property Service lines shall not be located under driveways. No meter pits will be allowed in a driveway, parking area or sidewalk.

4.2 SPECIFICATIONS

4.2.1 SCOPE: The work covered by these specifications concerns the furnishing of all labor, equipment and materials and performing all operations for the construction of the water distribution system including water lines, valves, air vacs, fire hydrants and other fittings and appurtenances in accordance with these specifications and the Standard Design Drawings in Paragraph 4.5.

4.2.2 GENERAL REQUIREMENTS: The water distribution system shall be constructed in accordance with engineered construction plans for the work, prepared under the direction of a professional engineer and approved by the Town Engineer.

1. Water Line Piping: all materials to be installed shall be free of defects. No defective materials shall be permitted to be installed or remain on the job site.
   a. Cast Iron Pipe (CIP): All CIP pipe shall be Class 150 push-on joint, cement mortar lined, cast iron pipe and shall conform to American Standard A 21.8 (AWWA C!)*), American Standard A 21.4 (AWWA C104) thickness class 22 CIP shall be bituminous coated with a minimum 1 mil thickness. Pipe is to be furnished in 18 or 20 foot laying lengths.
   b. Ductile Iron Pipe (DIP): all DIP shall be manufactured and tested in accordance with ANSI A21.51-1976 (AWWA C151-76). DIP shall have a bituminous coating on the outside of 1 mil thickness minimum and cement mortar lined to conform to ANSI A21.4 (AWWA C104). Thickness class and thickness design shall be as in ANSI. 50 (AWWA C150) and shall be a minimum thickness of 50. Pipe is to be furnished in 18 or 20 foot laying lengths.
   c. Polyvinyl Chloride Pressure Pipe (PVC): All PVC pressure pipe shall be AWWA C900 Johns Manville Blue Brute or approved equal. Pipe shall have outside dimensions (OD) construction. The standard dimension ratio (SDR) shall be 18 or 14, Class 150 or 200 pipe. Pipe is to be furnished in 20 foot laying lengths. Any PVC pipe damaged by tapping operations shall be replaced without expense to the Town of Lyons.
   d. Steel Pipe:
      1. Pipe is to be fabricated in accordance with AWWA Standard Specification C-200-75 from steel sheets conforming to ASTM A570 Grade C. Minimum wall thickness of steel shall be 3/16".
      2. Pipe is to be cement mortar lined inside in accordance with AWWA Standard Specification C-205 and coal tar enamel coated and wrapped outside with fibrous glass mat, 15# asbestos felt and kraft in accordance with AWWA

Standard Specification C-203. Cement mortar lined pipe shall have an I.D. after lining not less than the specified nominal size.

3. Pipe is to be furnished principally in 40 foot net laying lengths with special lengths as required by plan and profile for location of fittings. Pipe is to be furnished with O-ring joints unless otherwise noted on plan. Pipe fabricator shall prepare a pipe laying diagram or laying schedule showing the location of each piece by mark number. O-ring joint shall consist of a flared bell end and a grooved spigot and designed to retain the "O-ring" rubber gasket. The spigot end groove may be rolled in or bar type provided that there is no reduction in the cross sectional area of the pipe at the joint. Bell and spigot ends shall be sized by forcing over a sizing die or by expanding to stretch the steel beyond its elastic limit so that the clearance between outside of spigot and inside of bell at normal engagement does not1/16" measured on the circumference. The O-ring gasket shall have sufficient volume to approximately fill the area of the groove and shall conform to AWWA C-301 Section 3.4. The joint shall be suitable for a safe working pressure equal to the class of pipe furnished (not to exceed 250 psi) and shall operate satisfactorily with a deflection, the tangent of which is not to exceed .75" /D, where D is the outside diameter of the pipe in inches. Steel pipe shall be furnished from the manufacturer with an integral cadweld know for securing bonding wire to pipe. Field coating material shall consist of two wraps of 6" wide Protecto-Wrap #200 w/#1170 primer and shall be furnished by pipe fabricator. Shop applied outside coating shall be continuous to the end of pipe on the bell end and shall be cut back on spigot end so that coating extends at least ½" inside the bell end at normal engagement. Shop applied inside lining shall be continuous to the end of pipe on the spigot end and shall be cut back on the bell end to the point of maximum engagement or further as shown on plans. The inside surface of the bell and the outside surface of the spigot shall be painted one shop coat of quick dry chlorinated rubber compound per AWWA C-203 Section 2.1, type A or B.

2. Pipe Fittings: All fittings shall be cast iron cement mortar lined mechanical joint fittings Class 250 conforming to ANSI A21.10 (AWWA C101-67) and ANSI A21.11 (AWWA C111-72).

3. Valves:
   a. Gate Valves: All gate valves to conform to AWWA C500, Mueller or approved equal with cast or ductile iron bodies, bronze mounted, non rising stem with O-ring valve seals. Valves shall be double disc, parallel seats and operating pressure of 150 psi for sizes over 12", 200 psi for sizes under 12". Valves shall have 2" square operating nut and turn left to open.
   b. Butterfly Valves: butterfly valves shall be used for water mains 12" in diameter and larger. Valves shall conform to AWWA C504, Dressor type or approved equal with cast or ductile iron bodies, Class 125 including flanges. Valves shall have a 2" square operating nut and turn left to open.
   c. Main control Valves: The main valve shall be hydraulically operated an diaphragm actuated, glove or angle patterned. The main valve shall have a single removal

seat, plus a resilient, synthetic rubber disc retainer assembly, combining to insure a drip tight closure of the main valve when the cover chamber is pressurized. The diaphragm assembly of the main valve shall be fully guided both top and bottom by a bearing in the main valve cover and a integral bearing in the valve seat. No pistons or external packing glands are permitted or required as the diaphragm assembly shall travel within its guides virtually unrestricted.
The main valve shall be similar in all respects to the Clayton 100-01 Hytrol Valve as manufactured by Cla-Val Co., or approved equal, and shall be fully equipped to received a full range of compatible pilot systems designed for specific service applications.

d. Pressure Reducing Valve: This valve shall maintain a constant downstream delivery pressure regardless of varying inlet pressure. The valve system shall include a Clayton 100-01 Hytrol equipped wit a pilot control system consisting of (1) a pilot system strainer, 2) a fixed orifice in the control system, and 3) a pressure reducing pilot control which shall be a direct-acting, adjustable, spring-loaded, normally open, diaphragm valve, designed to permit flow through the main valve when controlling pressure is less than the spring setting of the pilot control. This valve system shall be similar in all respects to a Claton 90-21 Pressure reducing valve as manufactured by Cla-Val Co., or approved equal.

4. Fire Hydrants: Fire hydrants shall meet or exceed AWWA Standard C502-54 as follows: cast-iron body; fully bronze mounted; 150 psi working pressure; minimum five foot trench depth (four and one-half foot cover); six inch mechanical joint inlet; compression type main valve which closes with pressure; minimum five and one-quarter inch (5 ¼") main valve opening; two, two and one-half inch (2 ½") hose nozzles and one, five and one-half inch (5 ½ ") pumper nozzle; nozzle threads in conformance with National Standard ASA B26, (hydrant supplier shall confirm nozzle threads with Lyons Fire Protection district); nozzles shall be easily replaceable in the field with normal Water Department tools and equipment; operating and cap nuts shall be one and one-half inch #17 national Standard hex; main valve shall open right (clock-wise); direction of opening shall be shown by arrow cast on stamped on the top of the hydrant,. Fire hydrants shall have easily replaceable, "breakable sections" which permit a clean beak at or near ground level in the event of collision, without loss of water or injury to major parts of the hydrant. Working parts shall be removable for maintenance or repair without excavation. Operating mechanism shall be non-wetting, oil-reservoir lubricated, with O-ring seals. Barrel drain shall be bronze mounted with at least two outlets and shall operate automatically with the main valve. Fire hydrants supplied by the Contractor shall be pre-qualified in strict accordance with this specification.

4.3 CONSTRUCTION

4.3.1 GENERAL REQUIREMENTS: Section 7, General specifications shall be followed except as modified in Paragraph 4.3.2.

4.3.2 SPECIFIC REQUIREMENTS: The following specific requirements shall apply in the construction of the water distribution system:

1. Trench Depth: The trench shall be of sufficient depth to provide a minimum of 4 ½ feet from subgrade and a maximum of six (6) feet from finished grade of cover over the top of the pipe. Street to be at subgrade elevation prior to the installation of any water lines. The excavation of the trench shall not advance more than 200 feet of the pipe laying operation, except where permitted y the Town Inspector for drainage or other purposes.

2. Pipe Installation: During laying operations, no debris, tools, clothing, gravel or other materials shall be placed in the pipe. All joints will be made according to the pipe manufacturer's recommendations. Laid pipe shall be brought to correct line and grade. The pipe shall be secured in place by installation of the bedding material tamped under and along the pipe up to the springline of the pipe. At times, when pipe laying is not in progress, the open ends of pipe shall be closed by means of a water tight plug. The cutting of pipe for inserting valves, fittings, or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe or lining and so as to leave a smooth end at right angles to the axis of the pipe. Pipe ends shall be smoothed and beveled with a file or other tools according to pipe manufacturer's recommendations. The town Inspector shall be notified at least twenty-four hours in advance of when pipe is to be laid in any trench. No pipes shall be covered until they have been inspected by the Town Inspector.

3. PVC Pressure Pipe Installation: An insulated copper wire shall be placed and secured to the top of the pipe. The wire installation shall conform to the following:

   a. The wire shall be insulated No. 14 gauge single strand, direct bury electrical wire or heavier, but not more than a single strand.
   b. The splice used shall be a compression type splice.
   c. The wire shall extend up the inside of each valve box and be of sufficient length to be easily accessible.

   All valves and fittings on PVC installations shall be securely fastened and tied back to the main with all-thread rod to prevent any lateral movement. All valves and fittings shall have thrust blocks and be wrapped in 4 mil or heavier polyethylene plastic sheeting.

4. Thrust Blocks: all plugs, caps, tees, bends and hydrants shall be provided with cast-in-place concrete thrust blocking as shown on the Standard Design drawings in paragraph 4.5. The blocking shall be so placed that the pipe and fitting joints will be accessible for repair and separated from the concrete with a 8 mil of plastic sheeting. Bends in the vertical plane shall also be anchored with all-thread connections and fittings. All thread connectors and fittings shall be coated with Protecto Wrap #1200 mastic prior to concrete placements.

5. Valve and Hydrant Setting: Immediately prior to the installation of a valve or hydrant, the following operations shall be performed: The valve or hydrants shall be carefully inspected. The interior shall be thoroughly cleaned, the to determine that all parts are

in proper working order, with valves seating properly and the hydrants shall be operated as many times as necessary to determine that all parts are in proper working order, with valves seating properly and the hydrant drain valve operating properly. Valves and hydrants shall be set plumb and securely braced into place.
Hydrants shall be set as shown in the Standard Design Drawings in paragraph 4.5. Lateral piping to the hydrant shall be connected to a 6 inch gate valve with box, which has been all thread connected directly to a tee in the main. Hydrants shall be set with the bury line at the established finished grade and with hose nozzles parallel to the curb , with the pumper nozzle facing the curb and at least six inches behind the curb or sidewalk.
Valves shall be provided with valve boxes centered and plumb over the operating nut of the valve. The boxes shall be supported to prevent any shock or stress in this position during backfilling. Valve box covers shall be set to finished grade but may be first left just below subgrade level to prevent damage during street construction and later adjusted to grade at the time of paving. Hydrants shall be provided with a drainage pit with nine square feet of surface area and two feet of depth below the bottom of the pipe. Pits shall be backfilled with 1 ½ inch washed crushed rock to a level six inches above the barrel draining hole. Concrete reaction blocking shall be so placed so as not to obstruct the barrel draining hole.

6. Plugging and Marking Extremities: Standard plugs or caps shall be installed and thrust blocked against undisturbed soil at all extremities, unless provided with a blow-off or inline fire hydrant. Where blow-offs or fire hydrants are not called for, in addition to thrust blocking the end, a #9 wire shall be firmly attached to the plug or cap and connected to a 2" x 4" x 2' (redwood) board, buried above the end of the line and 1 foot below finish grade.

7. Filling and Venting the Line: All valves shall be operated by the Town maintenance personnel. The line shall be slowly filled with water and all air expelled from the pipe. Care shall be taken that all available hydrants (including hydrant gate valves), air valves an other vents are open during the filling of the line, the contractor shall make whatever taps are required for venting purposes. The rate of filling the line shall not exceed the venting capacity.

8. Disinfection and Flushing of Mains: Disinfection shall be done as follows: Chlorine dosage shall be at least 50 parts per million and shall be retained it eh line at least 24 hours. The chlorine residual at the pipe extremities and other representative points shall be at least ten parts per million. If the test is not satisfactory, the disinfection shall be repeated until a ten parts per million chlorine residual is obtained. Following chlorination, the main shall be thoroughly flushed throughout its extremities until the water runs sweet and clear with no chlorine residual in excess of that carried win the existing system. The Contractor shall take all necessary precautions to prevent the flow of strong chlorine solution into existing water facilities and will assume responsibility for damages done by heavily chlorinated water due to negligence on his part. No water mains shall be placed in service or tapped until a written release is obtained from the Town Administrator.

9. Restoration and Cleanup: Where construction is done in streets, the street shall be graded immediately after backfilling to provide drainage away from the trench. The Contractor shall restore or replace all removed or damaged paving, curbing, sidewalks, gutters, sod, shrubbery, fences, irrigation ditches, pipe or other structures or surfaces to a condition equal to that before the work began and to the satisfaction of the Town Inspector. The construction site shall be left clean and orderly.

10. Water Services: Water service shall be continuous length, without joints or connections, Type K copper, with flared connections from the water main to the curb stop. The diameter shall be that called for on the drawings.
    a. Corporation Stops: Mueller #H-15000, Fort F-600 or Hays 4201 will be furnished in place on the line by the Contractor. The Contractor shall make the tap after the line has been chlorinated, pressure tested and flushed.
    b. Curb Stops: Mueller #H15200 or Fort Type B-44-333 and Mueller H-10350 curb boxes or approved equals shall be installed as shown on Standard Drawing.
    c. Water Meters: Water meters of greater than 1 inch in six shall be installed in accordance with Figure 4-9.
        1) Specifications for Water Meter Settings – Inside Set:
            a. Meter CANNOT be placed in crawlspace, even if it is near crawlspace entrance.
            b. Meter must be tied into water system before water pipes branch off of outside spigots and other parts of the building or underground sprinkling systems.
            c. Meter must be easily accessible and not be put in a cramped space or near the ceiling.
            d. Conduit must extend six (6) inches from meter all the water to the bottom of remote readout.
        2) Specifications for Water Meter Settings – Outside Set:
            a. Meter pit must have a row of bricks at its base for a foundation.
            b. All fittings MUST be flared fittings, not sweated or compression fittings.
            c. The top of the meter yoke must be seven (7) inches below the top of the fiber board pit.
            d. The meter pit lid may not be covered before or after the inspection.
            e. The wire and conduit for a remote readout must be buried two (2) feet deep.
            f. Conduit must extend from inside the meter pit all the way to the bottom of the remote readout.
            g. The center of the meter pit lid should be approximately fifteen (15) inches fro the outside water shut-off curb stop box.
        3) Specifications for Water Meter Settings – Inside and Outside Sets:
            a. Conduit for a remote readout should be ½ inch PVC.
            b. Ninety degree (90') bends in conduit must be sweeping 90's.
            c. The remote readout must be 60 inches above ground level.
            d. Remote readouts must be in front of the building. Readouts may be on either side of the building but not more than five (5) feet from the front corner.

4.4 TESTING

4.4.1 COMPACTION TEST: Compaction tests to verify specified trench compaction shall be performed as required in Section 7 of this manual.

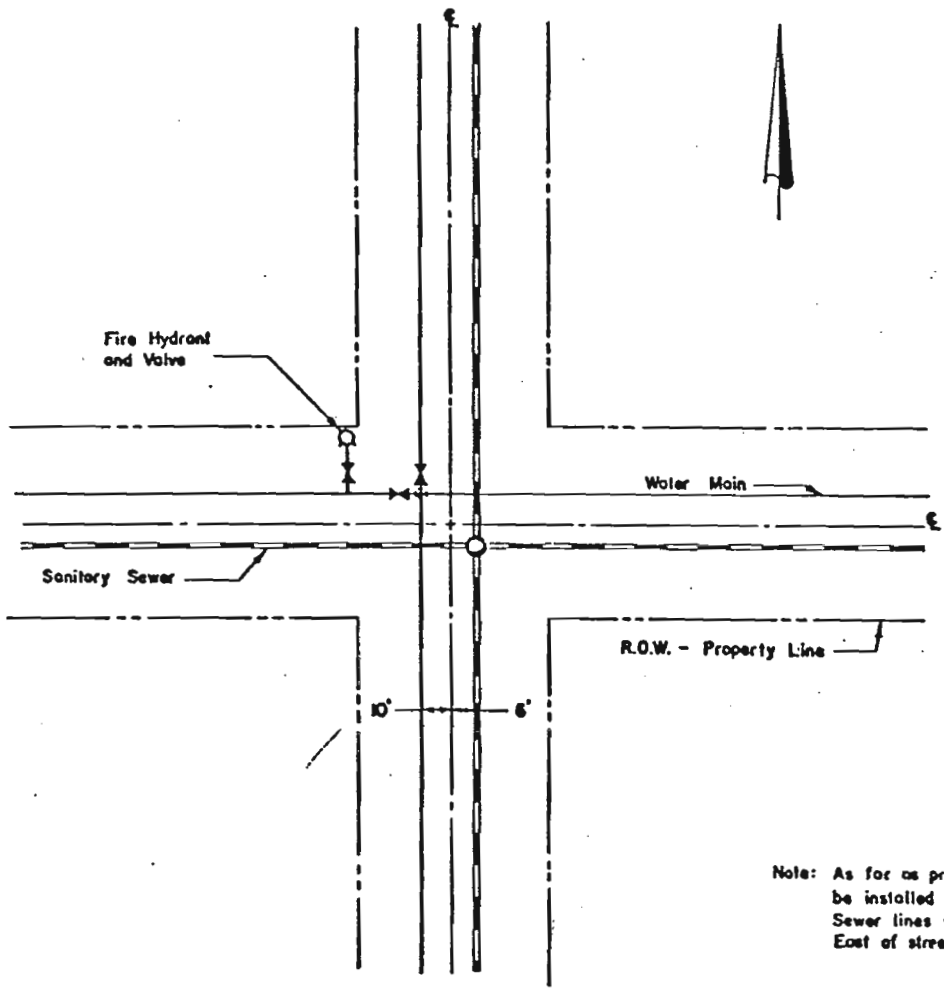
4.4.2 PRESSURE TEST: Pressure tests shall be conducted by the Contractor according to the applicable sections of AWWA C600 or AWWA C603 to a minimum pressure of 150 pounds per square inch at low point of section being tested. All joints and connections are to be water tight within tolerances allowed by the above specifications. Any leakage which is discovered by observation or test shall be located and made water tight by the Contractor. Testing shall be performed in the presence of the Town Inspector.

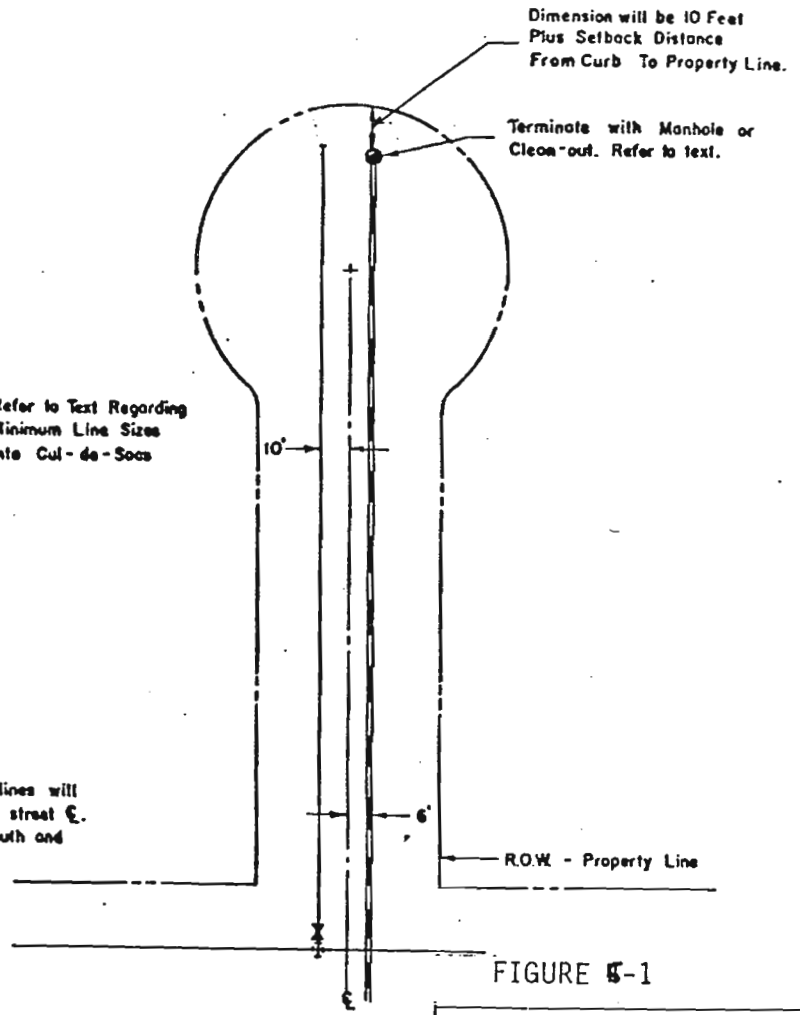
4.4.3 SOIL RESISTIVITY TEST: Prior to all water main installations, using other than PVC pipe, soil resistivety tests will be made by the Developer along the proposed lien and the following protection provided:

Test Reading	Pipeline Material	Protection
Less than 1000 ohms/ Cubic centimeter	Cast or Ductile Iron	Plastic sleeve shall be placed over entire length of pipeline and bedded in six (6) inches of sand in any direction.
1000 to 2000 ohms/ cubic centimeters	Cast or Ductile Iron	Entire length of pipeline shall be bedded in six (6) inches of sand in any direction.
Greater than 2000 ohms	Cast or Ductile Iron	Pipe shall be bedded in existing material per backfill specifications

4.5 STANDARD DESIGN DRAWINGS

FIGURE
- 4-1 Main Locations in Through Streets and Cul de sacs
- 4-2 Location of Fire Hydrants and Valves
- 4-3 Air Relief Valve Details
- 4-4 Watercourse Crossing Details
- 4-5 Water Tap Differentiation and Meter Location
- 4-6 Thrust Blocks
- 4-7 Fire Hydrant Assembly
- 4-8 Gate Valve And Valve Box Details
- 4-9 Meter Settings for tapes 1-1/2” and larger
- 4-10 Bore Crossing Details
- 4-11 Maximum Joint Openings for Steel and Rubber Pipe Joints

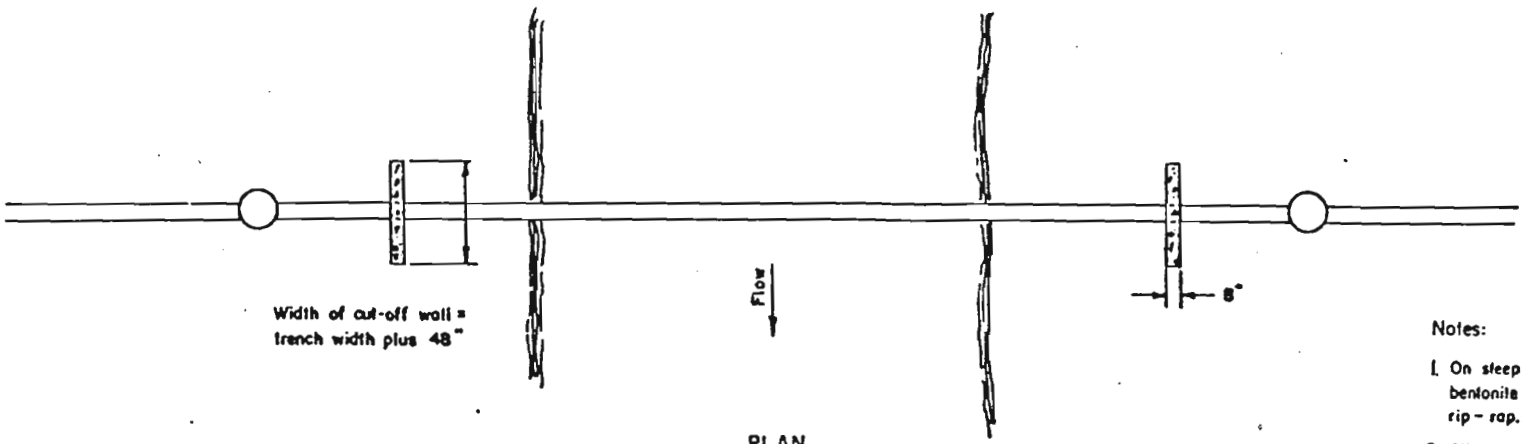




Note: As far as practible, all water lines will be installed North and West of street ℄. Sewer lines will be installed South and East of street ℄.

FIGURE 5-1

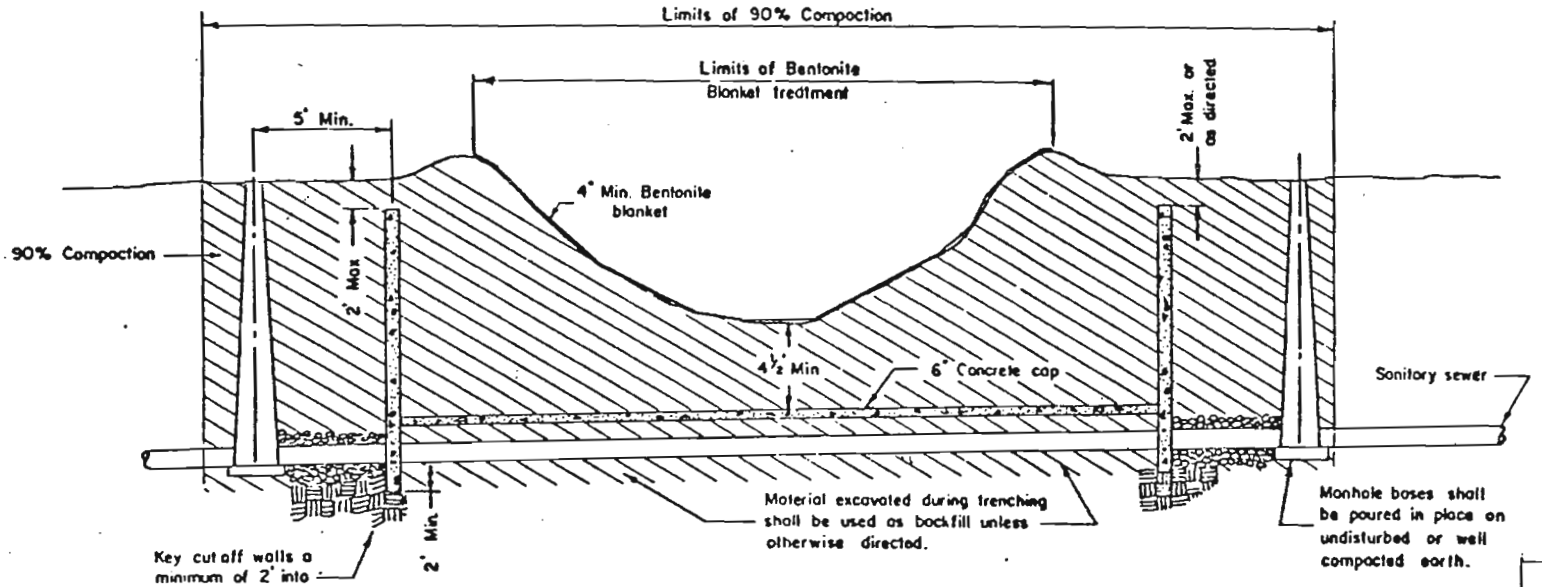
MAIN LOCATIONS IN THRU STREETS & CUL-DE-SACS



PLAN
Concrete cap not shown

Notes:

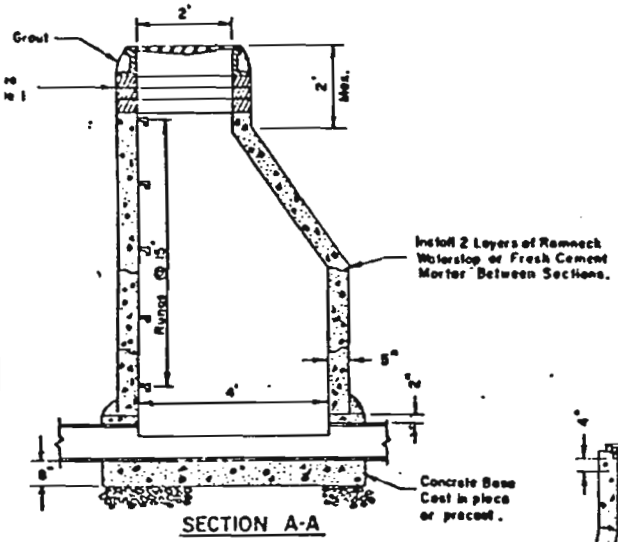
1. On steep slopes or as required by ditch company, bentonite blanket shall be protected by 1'-0" min. rip - rap.
2. All open cut crossings shall conform explicitly to these specifications or those of the ditch company, whichever is the more skringent.



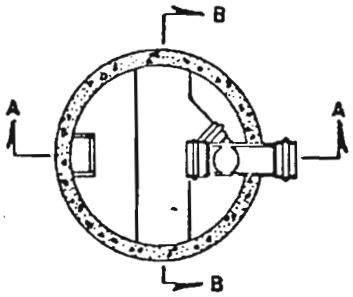
PROFILE
No Scale

FIGURE 5-2

CUT-OFF WALL DETAILS for OPEN CUT DITCH and RIVER CROSSINGS

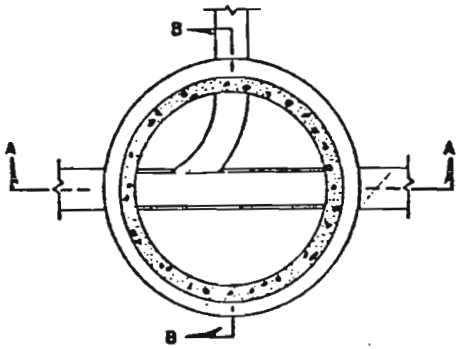


SECTION A-A

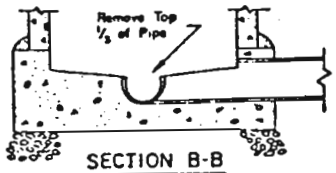


SECTION C-C

NOTES:
1. Plaster outside all brickwork when brick is used to raise manhole to final grade.
2. Maximum pipe size for inside drop manholes shall not exceed 8". Drop pipe and elbow shall be Johns-Manville Ring Tite sewer pipe only.
3. Inside drop pipe shall be secured to wall with aluminum strap and expansion bolts.
4. All manhole bases shall have a troweled finish.
5. All manhole bases shall be set on a minimum of 12" of approved trench gravel. Continuity with pipe bedding shall be assured.
6. Provide Flexible Joints A Maximum of 18" from manhole walls.

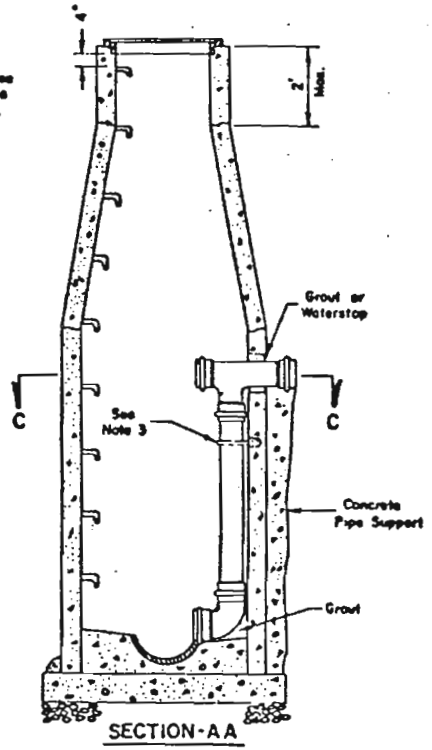


BASE PLAN

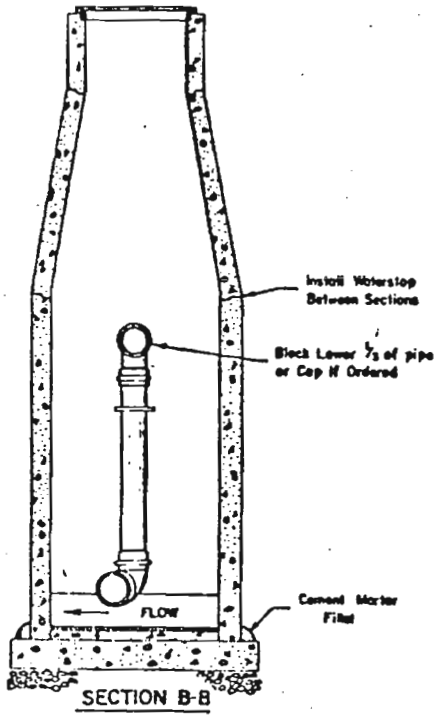


SECTION B-B

FLOW-THROUGH MANHOLE with LATERAL

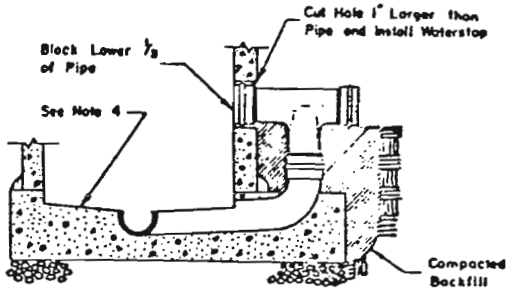


SECTION-AA



SECTION B-B

INSIDE DROP MANHOLES



OUTSIDE DROP MANHOLES

FIGURE 5-3

STANDARD MANHOLE DETAILS

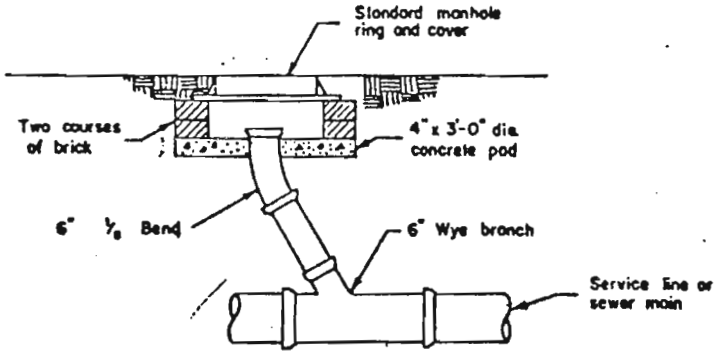
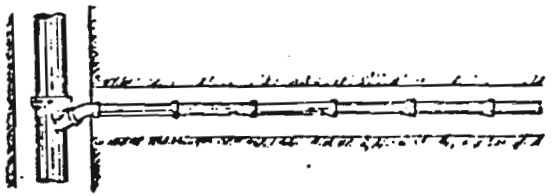
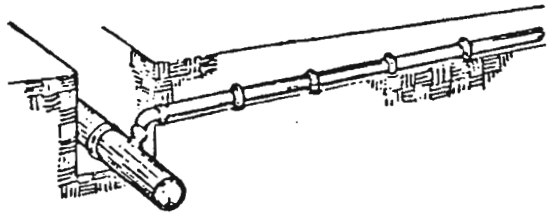


FIGURE 5-4

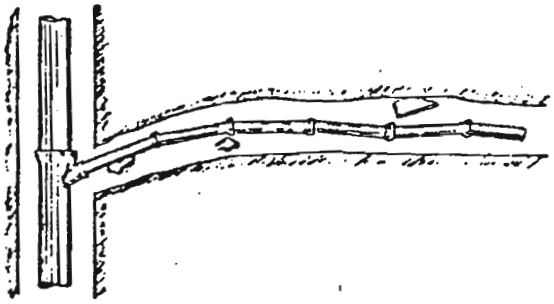
SEWER CLEAN-OUT DETAILS

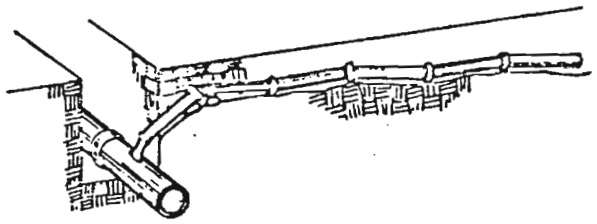




CORRECT

Straight alignment and proper fitting give tight joints and maximum strength. Bell holes allow pipe to be uniformly supported on barrel. Uniform grade of not less than $\frac{1}{8}$" drop per foot of run





INCORRECT

Unnecessary curves and improper fitting impedes flow and reduces carrying capacity. Uneven bedding, lack of bell holes and rocks or debris in trench ma couse shifting of pipe during backfilling or inadequate support of the pipe.

FIGURE 5-5

TYPICAL SEWER SERVICE LINE INSTALLATION

General Notes:

1. No vent terminal with Return Bend shall be located directly beneath any floor, window, or other ventilating opening of the building or adjacent building nor shall any vent terminal be within 12 feet horizontally of such an opening unless it is at least 3 feet above the top of such opening. Any vent terminal which may, at any time, vent flammable or toxic gas, shall terminate not less than 10 feet above grade. Vent terminals extending through a wall shall be at least 12 feet horizontally from any building line and shall be turned to provide a downward opening. Vent terminals shall be screened.

2. Location of trap and piping depends on fire regulations. If a gas tight cover is provided, trap may be installed inside. Extra heavy cast iron soil pipe is required if inside or within 5 feet of building.

3. Dimension 'B' is a minimum of 24" for sand traps only.

4. Dimension 'C' is a maximum of 18" for combination oil and sand traps.

5. Minimum capacity of oil and sand traps shall be 6 cubic feet plus 1 cubic foot for each 300 gallons used during a 24 hour period. Flow rate shall not exceed the rated capacity and shall operate at a minimum overall efficiency of 90%.

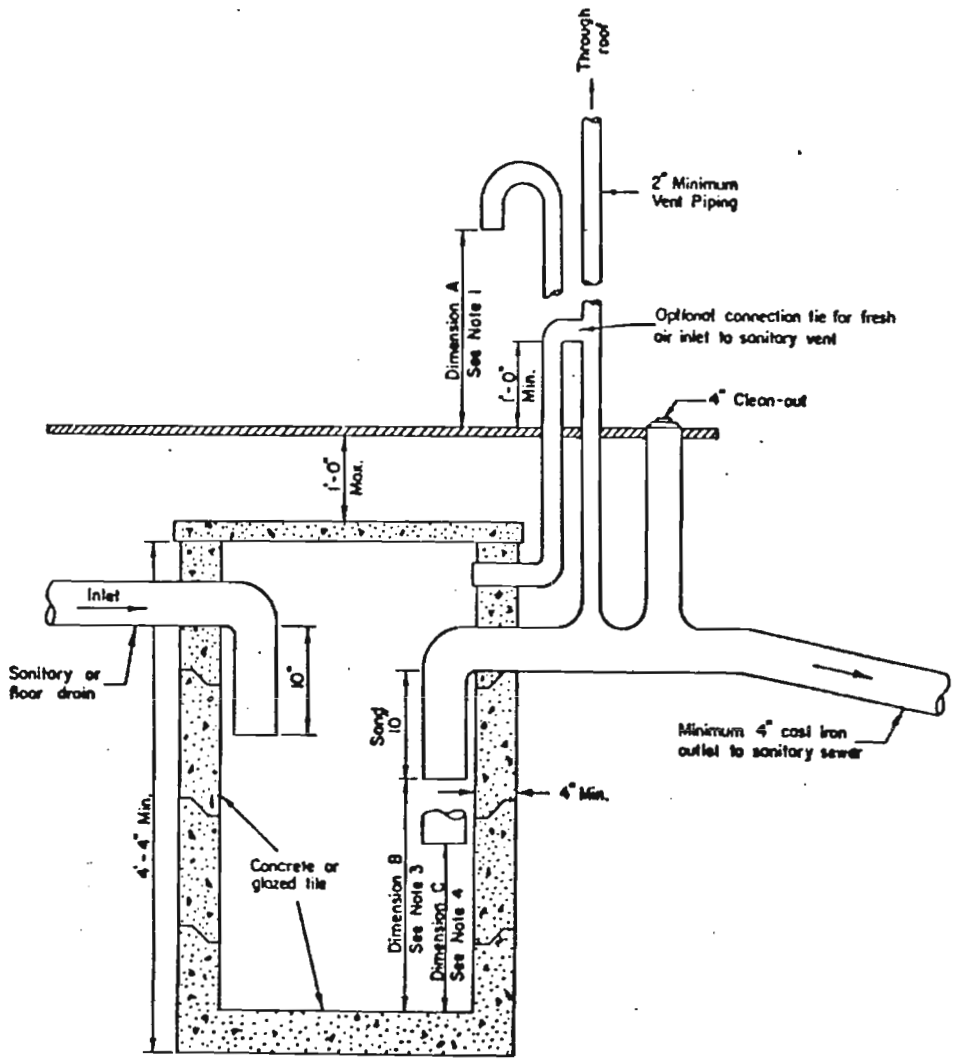


FIGURE 5-6

COMBINATION OIL, GREASE AND SAND INTERCEPTOR

SECTION 5
WASTEWATER COLLECTION SYSTEM

5.1 Design Criteria

5.1.1 SUBMISSIONS:

1. Wastewater Collection System Public Improvement Plans: The Public improvement plans shall describe the proposed wastewater collection system in adequate detail so as to serve as construction drawings as well as satisfying the requirements of this section.
2. Wastewater Collection System Report: A wastewater collection system report shall be submitted with the final plat describing the basis for the design of the wastewater collection system and shall include b not be limited to:
   a. Computations indicating flow depths and velocities at minimum, average and peak daily waste flows.
   b. Design capacity for wastewater lift stations when required.
   c. Anticipated peak daily wastewater water flow from the subdivision.

5.1.2 METHOD: The design of the wastewater collection system shall be based on standard design practices and design criteria contained in this section.

5.1.3 CRITERIA: The design of the wastewater collection system shall be base don the following:

1. Flow: The system shall be designed for the estimated ultimate tributary population. Minimum average flow rate for residential areas shall be 100 gallon per capita per day. Residential peak flow rates are given in Table 5-1. These residential flow rates include normal infiltration. Additional allowances shall be made where inflow or excessive infiltration conditions exist.

TABLE 5-1

Line	Residential Peak Flow (gal/capita/day)
Lateral	400
Trunk	250

Minimum residential population density shall be figured on a basis of 3.5 persons per house, 4.0 houses per acre, and 70 percent of total land area developed as residential. Institutional, commercial and industrial sewage contribution estimates shall be reviewed with the Town Engineer. Sewers 10 inches in diameter and smaller shall carry the peak flow at a maximum flow depth of three quarters (75%) of the pipe diameter. Trunk sewers 12 inches in diameter and larger may be designed to flow full at the peak flow rate. The minimum velocity at the speak flow rate shall be 2.0 feet per second. Where actual flow will be much below normal for several years the minimum velocity shall be achieved by suitable grades at the partial design flow rate. Care shall be taken to design invert elevations at manholes in such a manner that the energy gradient is consistently falling in the direction of flow. Maximum allowable velocity shall not exceed 15 ft./sec. without making special provisions to protect against pipe displacement by erosion or shock.

2. Wastewater Collection System Layout:

a. Location: Sanitary sewer mains are to be in local or collector streets 6 feet west or south of the street centerline as shown in figure 5-1. Mains that are installed in easements or alleys shall ordinarily be located in the center of the easement or alley. When sanitary sewer mains are placed along back lot lines, they shall be located in a manner that provides access for maintenance crews.

b. Alignment: Between manholes sewer lies shall be straight, both in line and grade.

c. Cul-de-sacs: Sewer lines into cul-de-sacs shall extend so that the maximum distance from the sewer line to the curb at the closed end of the cul-de-sac shall not exceed 10 feet as shown in Figure 5-1. Sewer lines shall terminate with a cleanout or a manhole.

d. Slope: The following are the minimum sewer line slopes which are acceptable:

PIPE SIZE	MINIMUM SLOPE IN FEET PER 100 FEET
8 inches	0.40
10 inches	0.28
12 inches	0.22
14 inches	0.17
15 inches	0.15
16 inches	0.14
18 inches	0.12

Sewers on 20 percent slope or greater shall be anchored securely. Anchor spacing shall be as follows:

(1) Not over 36 feet center to center on grades from 20 percent to 35 percent.
(2) Not over 24 feet center to center on grades from 35 percent to 50 percent.

e. Separation of water mains, storm-sewer lines, and sanitary-sewer lines shall be as specified in the General Specifications, Section 7.

f. General excavation, trenching, backfill, and compaction requirements are specified in the General Specifications, Section 7.

g. Wherever the sewer main crosses under an open ditch, canal or creek, an approved cut-off wall shall be constructed on the lower side of the crossing to prevent w3ater from following the sewer trench. See Figure 5-2.

3. Inverted Siphons: Inverted siphons shall have not less than 2 barrels with minimum pipe size of 8 inches. The minimum design velocity for average flow is three (3.0) feet per second. The inlet and outlet shall be designed to permit the diversion of normal flow into either barrel so that either barrel may be out of service for maintenance.

4. Manholes: Manholes shall be installed at the end of each line; at all changes in grade, size, or alignment ; at all intersections, and at distances not greater than 400 feet for lines 15 inches or smaller or 450 feet for lines 18 inches or larger. Cleanouts may be provided instead of a manhole at dead ends if the total length above the last manhole is less than 100 feet and a maximum of four residential connections are to be made upstream of the last manhole. Minimum manhole diameter shall be four (4) feet. Manholes shall be stubbed out with suitable size pipe and plugged wherever future lateral extension of the sewer is anticipated. Where drains are to be constructed under sewer mains, cleanouts shall be provided at each manhole for the underdrain.

5. Cover: A minimum of 4 ½ feet of cover from the top of the pipe to finished grade is required.

6. Sewage Lift/Pumping:
   a. Every effort shall be made in the design of the sewage collection system to minimize the need for sewage pumping stations. In those areas where a pumping station has been tentatively approved, the following information must be provided before the final design approval will be given:
      1. Complete manufacturer's specifications.
      2. Capacity's as based on estimated peak wastewater flow.
      3. Stations shall provide 200% of firm (reserve) capacity of estimated peak flows.
      4. Rated horsepower

   b. Lift stations shall utilize a centrifugal pumping unit of the wet well/dry well type. At least two units shall be provided in each pumping station with each unit supplying 100% back-up capacity. The equipment shall be designed to operate on 3-phase power. The electrical controls shall provide for automatic alteration of equipment and automatic start up of the additional units if the first unit should fail to start. Electric connections for Town stand-by power unit shall be provided.

   c. Facilities shall be provided for the removal of pumps and motors.

   d. Pumps shall be non-clog type capable of passing a sphere of at least three inches in diameter. Pump suction and discharge opening shall be lat least four inches in diameter.

   e. Adequate positive air displacement for ventilation shall be provided for vaults and dry wells. The ventilation should provide at least 30 complete air changes per hour.

   f. Wet wells shall have a minimum holding capacity of 2 hours of design flow as based on estimated peak wastewater flow.

   g. Telemetric alarm systems shall be provided and shall activate in case of power failure, pump failure, or pump station malfunction and shall be connected to a monitor station the location of which shall be designated by the Town Engineer.

h. Vaults shall have gas detection equipment monitoring holes provide access without entering vault. Safe and suitable means of access shall be provided to all areas which have mechanical and electrical equipment which must be inspected and maintained. Vaults shall also be equipped with a dehumidifier and a sump pump located at the low point of the vault floor.

7. Force Mains:
   a. At design average flow, a cleansing velocity of at least two feet per second shall be maintained.
   b. Air relief valves shall be placed a high points in the force main.
   c. Force mains shall enter the gravity sewer system at a point mot more than two feet above the flow line of the receiving manhole.
   d. All force mains shall be constructed of approved C-900 water pipe with the tracing wire.

8. Service Connections: Wyes shall be provided in the sewer main for service connections at each lot or building site and shall be shown on the plans. These fittings shall ordinarily be located feet from the centerline of the lot and at least 10 feet horizontally from any water service line. Service connection shall not be made at manholes.

5.2 SPECIFICATIONS

5.2.1 SCOPE: The work covered by these specifications concerns the furnishing of all labor, equipment and materials and performing all operations for the construction of the wastewater collection system including sewer lines, manholes and lift stations in accordance with these specifications and Standard Design Drawings in paragraph 5.5.

5.2.2 GENERAL REQUIREMENTS: The wastewater collection system shall be constructed in accordance with engineered construction plans for the work, prepared under the direction of a professional engineer and approved by the Town Engineer.

5.2.3 MATERIALS:

1. Sewer line Piping:
   a. Polyvinyl Chloride Pipe: PVC: All PVC sewer pipe shall be unplasticized polyvinyl chloride plastic gravity sewer pipe "J-M Ring-Tite PVC Sewer Pipe" by Johns-Manville or approved equal with integral bell and spigot joints. Pipe shall be made from clean virgin approved Class 11332-B PVC compound conforming to ASTM resin specification D1784. The pipe shall be suitable for use in gravity sewer conduit with provisions made for contraction and expansion at each joint with rubber ring. The bell shall consist of an integral wall section stiffened with two (2) PVC retainer rings which securely lock the solid cross section rubber ring into position. Standard lengths shall be twelve and one-half (12 ½) feet. The minimum wall thickness of the eight (8) inch pipe shall be 0.24 inches and for the twelve (12) inch pipe shall be 0.36 inches. The pipe stiffness at five (5) percent deflection shall be forty-five (45) when calculated in accordance with ASTM Designation D, 2412 "External Loading Properties of Plastic Pipe by Parallel-Plate Loading." Joint tightness shall be subject to an internal hydrostatic pressure of twenty-five (25) psi for one (1) hour.

Installation of PVC pipe and fittings shall be in accordance with ASTM Designation D-2321-67 and these specifications.

Type M or O rubber gaskets shall be placed around the OD of the pipe where the line enters or leaves any structure or encasement which rigidly holds the pipe (manholes, cut-off walls, etc.). Gaskets shall be placed ± 4" back from each face of the encasement to act as a water stop and compensate for differential shrinkage.

Special care shall be taken to place a pipe joint within 4 feet of each side of any structure or encasement which rigidly holds the pipe.

b. Concrete Sewer Pipe: All concrete sewer pipe shall be reinforced concrete pipe conforming to ASTM C-76-76 with rubber gasketed joints in conformance with ASTM C443-76. Internal pipe walls shall be reasonably smooth and free of defects. Pipe that is rough and/or uneven shall be reworked or removed from the job site.

c. Cast Iron Pipe: Cast Iron pipe, shall conform to ASA 21.6-1962 or A21.8-1962 Specifications. Joints shall be of the bell and spigot type, rubber gasketed and conform to ASA Designations A21.11-1964. Joints between cast iron and other types of pipe herein designated shall be water tight and structurally sound, with a smooth continuous invert.

2. Manholes:

a. Precast Reinforced Manhole Sections: Precast manhole sections shall conform to ASTM Designation C478-70 except as modified here and in Figure 5-3 of paragraph 5.5.
Concrete: shall have a minimum 28-day compressive strength of 3500 psi, and be placed with a slump not to exceed five (5) inches.

Minimum wall thickness shall be 5" to and including 60" diameter manholes. 72" diameter manholes shall have a 6" minimum wall thickness.

Flat covers, where called for in the plans, shall have a minimum thickness of 8 inches, reinforced with a double mat of steel. Openings in flat slabs shall be additionally reinforced. Straight rods used to reinforce openings shall have a minimum length equal to the diameter of the opening plus 2 inches.

Precut sections shall be set in mortar of ramneck so as to provide a water-tight joint.

b. Manhole Foundation: Bases for manholes shall be a minimum of 8" thick and made of Portland Cement Concrete with a minimum 28 day compressive strength of 3500 psi and having a slump not to exceed 3 inches at a time of placement. Pre-cast sections set on the foundation shall be set in mortar or ramneck so as to provide a water-tight seal at the manhole base.

c. Manhole Steps: Steps shall be an aluminum magnesium silicide type alloy conforming to Federal Specification QQ-A-200/8. Steps shall be non-skid COMCO FOUNDRY, INC. #12653B or approved equal, non-staggered and installed on 15" vertical centers.

d. Manhole Rings and Covers: manhole rings and covers shall be gray cast iron conforming to ASTM Designation A-48 free from cracks, holes, swells, cold shutes and having a smooth workmanlike finish. Rings and covers shall be COMCO FOUNDRY, INC. #C-1161 or approved equal, having machined metal bearing surfaces and the word "sewer" imprinted.

3. Mortar: Mortar shall be composed of one (1) part Type II cement to two (2) parts sand, thoroughly mixed dry and then having only that amount of water added and mixed to form a paste of workable consistency. Mortar shall be freshly made and no re-tempered mortar nor mortar that has obtained its initial set shall be used.

4. Plugs: a water tight compression plug, as recommended by the manufacturer, shall be installed to seal all dead ends and wyes.

   NOTE: At all ends and wyes, the contractor shall attach a 9 gauge steel wire to the plug and extend the wire vertically to within 12" of finish grade, where the wire shall be attached to the equivalent of 2" x 4" x 24" section of timber.

5.3 CONSTRUCTION

5.3.1 GENERAL REQUIREMENTS: Section 7, General Specifications shall be followed except as modified in paragraph 5.3.2.

5.3.2 SPECIFIC REQUIREMENTS: The following specific requirements shall apply in the construction of the wastewater collection system:

1. Trench Depth:

a. Pressured Sewer lines: The trench shall be of sufficient depth to provide a minimum of 4 ½ feet of cover over the top of the pipe, at subgrade. Street to be at subgrade elevation prior to installation of any sewer line.
b. Gravity Sewer lines: Depth determined by engineered drawings.

2. Pipe Installation: Sewer lines shall be constructed continuously upgrade from the lowest point, with the spigot ends pointing in the direction of the flow. Special care shall be taken to lay sewer pipe to exact line and grade. Pipe bedding material shall be placed in the trench bottom, to the thickness specified, to provide a uniform and continuous bearing support for the pipe at every point between bell holes. Preparatory to making pipe joints, all surfaces of the joint shall be clean and dry. Lubricants, primers, etc.., shall be used as recommended by the manufacturer. The pipe shall be set in position and checked for line and grade using care to keep the joint absolutely free of dirt. When final grade is established, the joint shall be carefully pushed home using appropriate methods of leverage. Care shall be taken so that the bell end

of the pipe will not be deflected to the extent that the gasket is pinched or rolled. Adjustment in line or grade may then be made by working the bedding material in around the pipe.

If O-ring gaskets are used, immediately after completing the joint, the seating of the gasket shall be checked around the entire circumference of the pipe, by visual and finger inspection. The pipe shall be secured in place by installation of the bedding material tamped under and along the pipe barrel up to spring line.

All sewers shall be kept thoroughly clean and free from gravel, dirt and debris. Whenever work ceases for any reason, the unfinished end of the pipe shall be securely closed with a temporary tight fitting plug.

The Town Inspector shall be notified at least twenty-four hours in advance of when of when pipe is to be laid in any trench. No pipes shall be covered until they have been inspected by the Town Inspector. The entire wastewater collection system must be installed an inspected prior to the tie-in to the existing system.

3. Manholes and Cleanouts: Manholes and cleanouts shall be constructed in accordance with Figure 5-3 and Figure 5-4. Manhole bases shall be constructed with flow through channels made to conform in shape and slope to that of the sewers. Sewer lines will not be permitted to be laid through the manhole. Precast manhole sections shall not be placed on the foundations until after it has reached sufficient strength to provide support without damage. The top of the bench shall be thoroughly cleaned and wetted with water. While the bench is still moist, a full mortar bed at least 1 inch in thickness shall be applied to the pre-cast section bearing seat. The first precast section shall be carefully lowered onto the bench so that the mortar bed will be forced out from under the section evenly on all sides. Each succeeding precast section shall be jointed in a similar manner and smoothly finished, inside and out. All lifting holes and other imperfections in the interior surface of the manhole shall be filled with cement mortar. Ramneck may be used in the joints in lieu of mortar.

   The influent and effluent lines in a manhole shall have a rubber stop placed around the pipe. The rubbers stop shall consist of a rubber ring and stainless band as manufactured by Armco Steel Corp. or approved equal.

   Manhole cover rings shall be installed on a minimum of two courses and a maximum of six courses of brick above the precast lid or cone or top of the brick taper section. Manhole rings shall be set in a full bed of mortar to the grade called for on the plans. In areas where a bituminous wearing surface is to be laid, the manhole lids and covers, or clean-out covers, shall be laid to base course elevation raised to finished grade elevation after bituminous surfacing has been completed. Bituminous material removed for raising shall be replaced with Portland cement concrete and protected for seven (7) days from any loading or freezing.

4. Connection to Existing Manholes: Sewer pipe connections to existing manholes, where there is not existing pipe stubbed out, shall be made in such a manner that the finished work will conform as nearly as practicable to the essential requirements specified for new manholes. The contractor shall break out as small an opening in the existing manhole as necessary to insert the new sewer pipe. The existing concrete foundation bench shall be chipped to the

cross-section of the new pipe in order to form a smooth continuous invert similar to that which would be formed in a new concrete base. Cement grout shall be used as necessary to smoothly finish the new invert and to seal the new line so the junction is watertight.

5. Restoration and Cleanup: The Contractor shall restore or replace all removed or damaged paving, curbing, sidewalks, gutters, sod shrubbery, fences, irrigation ditches, pipe or other structures or surfaces to a condition equal to that before the work began and to the satisfaction of the Town Inspector. The construction site shall be left clean and orderly at the end of each work day.

6. Sewer Service Line Connections: In all new developments, the sewer main shall be installed with wye services or tees for each plotted lot prior to installation of curb and gutter. Locations shall be marked with a #20 copper wire with yellow insulation run from the plugged end up 12 inches below the ground surface and teed off to a 24 inch piece of 2 inch by 4 inch lumber. As-built measurements shall be made by the Contractor to reference the wye or riser connection to the nearest manhole before backfilling.

    a. The service lien shall be laid in bedding and cover similar to the sewer main along its entire length.
    b. The Service line from the main to the building cast iron footing stub shall be one type of materials such as all plastic, not portions of each.
    c. Services for service stations, car washes, food processing establishments, etc. shall have a grease and/or sand trap installed on their service lines. The trap shall be constructed to the standards as defined in Chapter 7 of the Uniform Plumbing Code.
    d. The minimum grade of the sewer service line shall be one-eighth (1/8) inch drop per foot for lines 6" and larger. Minimum grades for 4" diameter lines shall be one-fourth (1/4) inch per foot.
    e. Sewer service lines shall not be laid closer than 10' from and water service lines. In those locations, i.e., cul-de-sacs, where it is not possible to meet this requirement, benching will be permitted provided that such benching meets the requirements as set forth in the Uniform Plumbing Code or the sewer service line may be encased in concrete in accordance with Section 7.
    f. In most cases, sewer services will not be permitted to be laid under driveways. In those instances where this requirement cannot be met, the final location will be determined by the city Inspector.

5.4 TESTING

5.4.1 COMPACTION TEST: Compaction tests to verify specified trench compaction shall be performed as required in Section 7 of this manual.

5.4.2 INFILTRATION AND EXFILTRATION: Infiltration and exfiltration shall not exceed 200 gallons/inch diameter/5280 LF/24 hours for the entire wastewater collection system.

Tests for water tightness shall be conducted by the contractor at his own expense and in the presence of the Town Inspector on all new sewer construction prior to final acceptance: in the following manner:

a. Manhole: (applicable test should be determined by the Town Inspector)

(1) Water Test: fill to 5 feet over sewer pipe for 2 hours; maximum lost ¼".

(2) Vacuum test: plug and brace all penetrations; instll pipe 5psig rated plugs beyond boot seals; secure vacuum apparatus; start vacuum. If leaks are evident; locate, excavate seal retest and re-backfill; attain a vacuum of 10" hg; time pressure drop to 9" Hg; release vacuum. Refer to chart for minimum test times.

Table 1. Minimum test times for various manhole diameters (ASTM C1244-93).

Depth (ft.)	Diameter (in.)								
	30	33	36	42	48	54	60	66	72
	Times (s)								
8	11	12	14	17	20	23	26	29	33
10	14	15	18	21	25	29	33	36	41
12	17	18	21	25	30	35	39	43	49
14	20	21	25	30	35	41	46	51	57
16	22	24	39	34	40	46	52	58	67
18	25	27	32	38	45	52	59	65	73
20	28	30	35	42	50	53	65	72	81
22	31	33	39	46	55	64	72	79	89
24	33	36	42	51	59	64	78	87	97
26	36	39	46	55	64	75	85	94	15
28	39	42	49	59	69	81	91	101	113
30	42	45	53	65	74	87	98	108	121

b. Sewer line air test: The section of sewer line to be tested must be pressurized to a minimum of 4# psi. The sewer line cannot exceed loss of .6# psi in 4 minutes.

Infiltration or exfiltration tests shall also be conducted whenever, during the course of construction, infiltration appears to be greater than the maximum allowed or the quality of workmanship is questionable. Whenever the rate of infiltration or exfiltration is found to exceed the prescribed amount, the Contractor shall stop all construction. The Contractor shall make appropriate repairs by methods approved by the Town Engineer and shall continue to test the conduit until it is satisfactory.

5.4.3 VISUAL TEST: All lines shall be jetted and camera tested with standard video equipment and the video tapes released to the Town Inspector prior to acceptance of the improvement. All lines are subject to being lamped and a sewer ball of appropriate diameter may be required to be forced through the line by water at the discretion of the Town Inspector. The Town Inspector must be given 24 hours notice prior to the process. The Contractor shall remedy, at his own expense, any poor alignment or any other defects in workmanship or materials as found by the Town Inspector. Final acceptance will be based on re-inspection of the sewer after the appropriate repairs and corrections are completed.

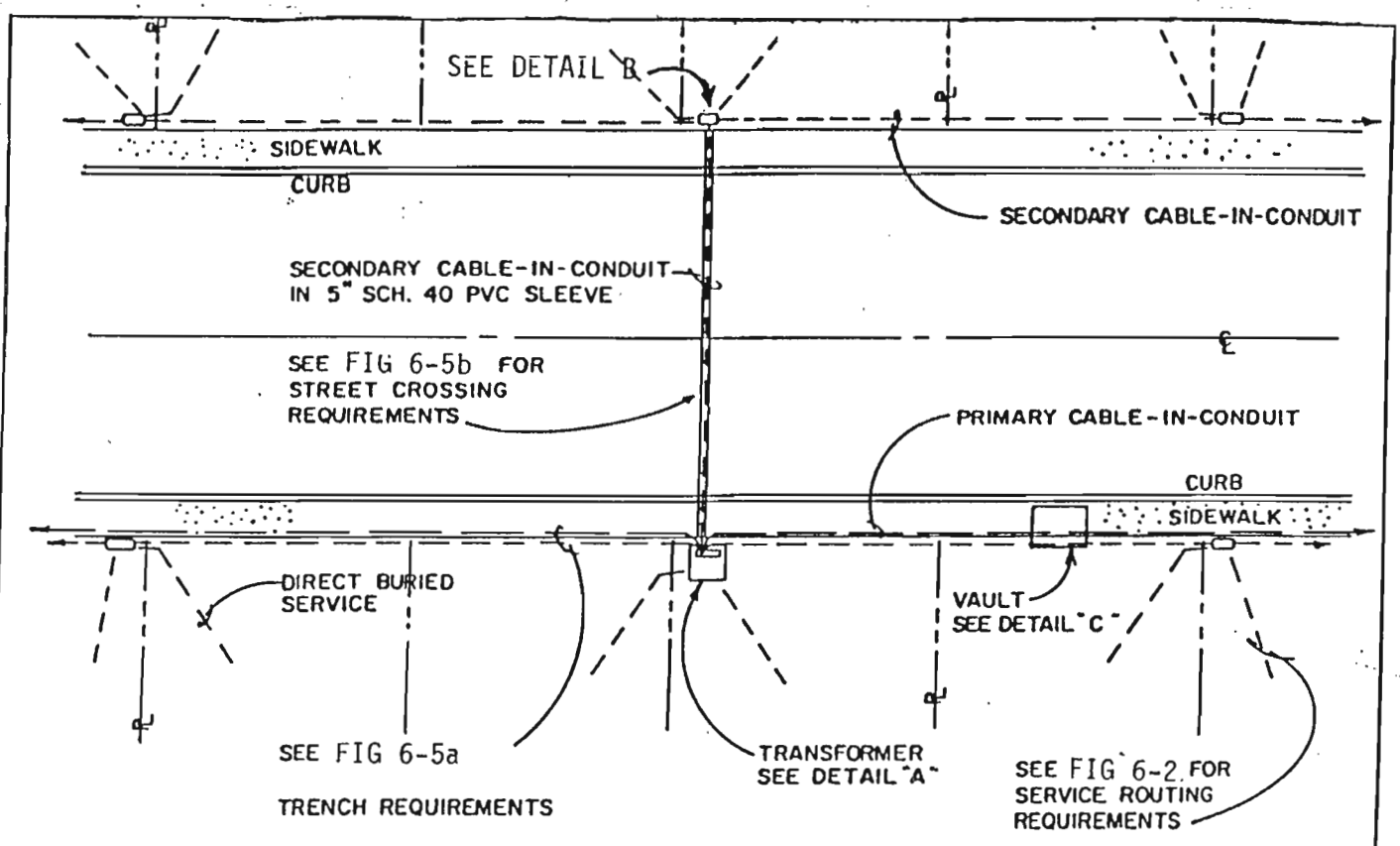
5.5 STANDARD DESIGN DRAWINGS

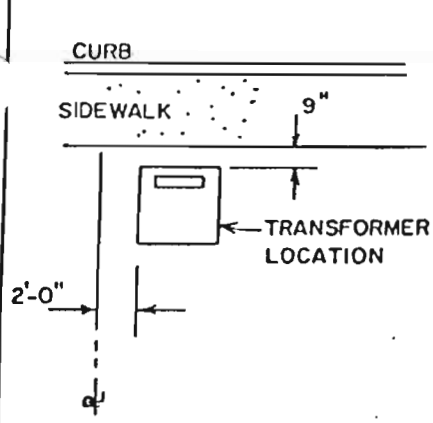
Figure 5-1 Main Location in Thru Streets and Cul-de-sacs
Figure 5-2 Cut-off Wall Details For Ditch & River Crossings
Figure 5-3 Standard Manhole Details
Figure 5-4 Sewer Clean Out Details
Figure 5-5 Typical Sewer Service Line Installation
Figure 5-6 Combination Oil, Grease & Sand Integrator

ADDITIONAL NOTES:

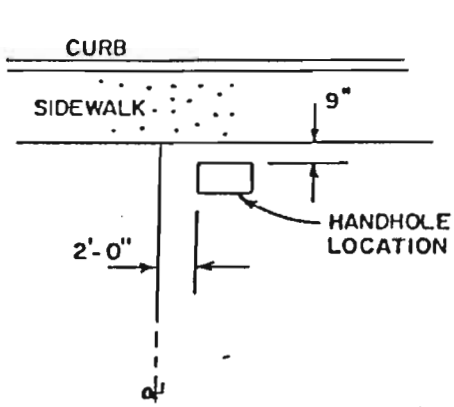
Date:_____ Comments: _____
_____
_____
Town Admin Approval: _____
_____ _____

Date:_____ Comments _____
_____
_____
Town Admin Approval: _____
_____ _____

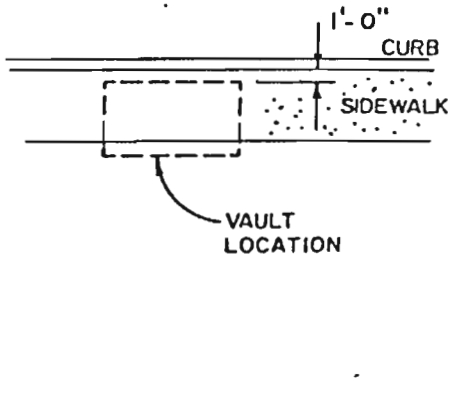




DETAIL "A"
N.T.S.

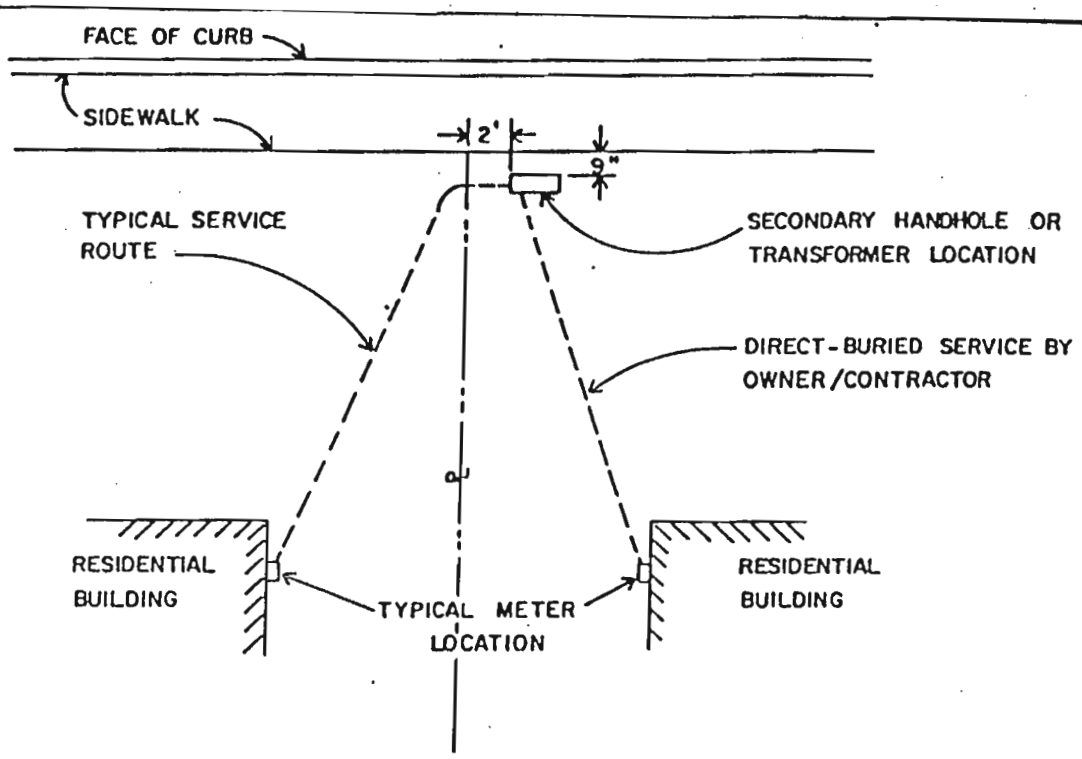


DETAIL "B"
N.T.S.



DETAIL "C"
N.T.S.

DISTRIBUTION PLAN
FIG 6-1

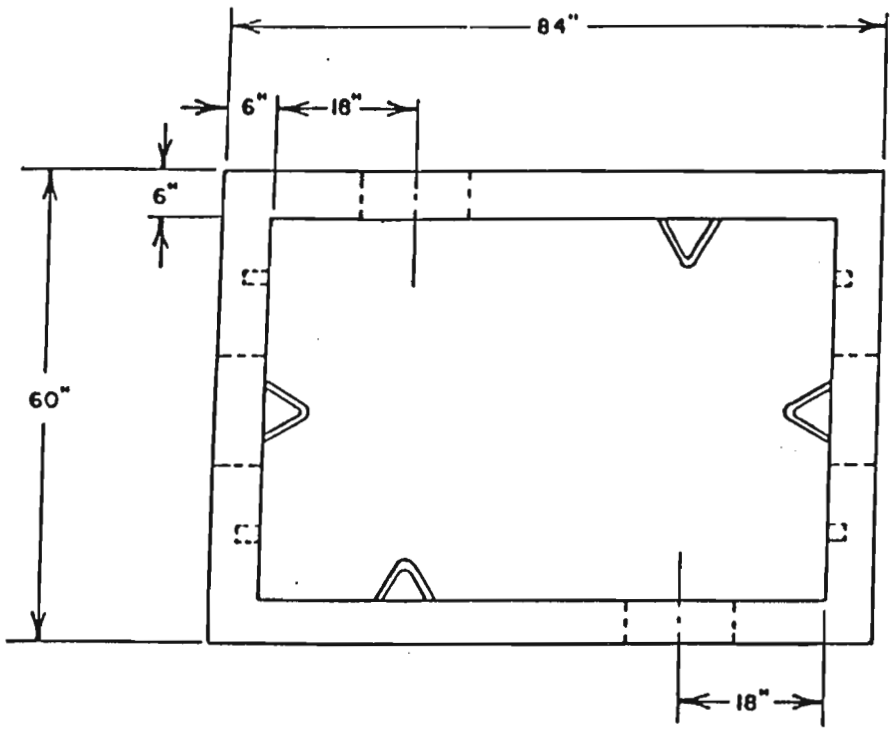


NOTES:

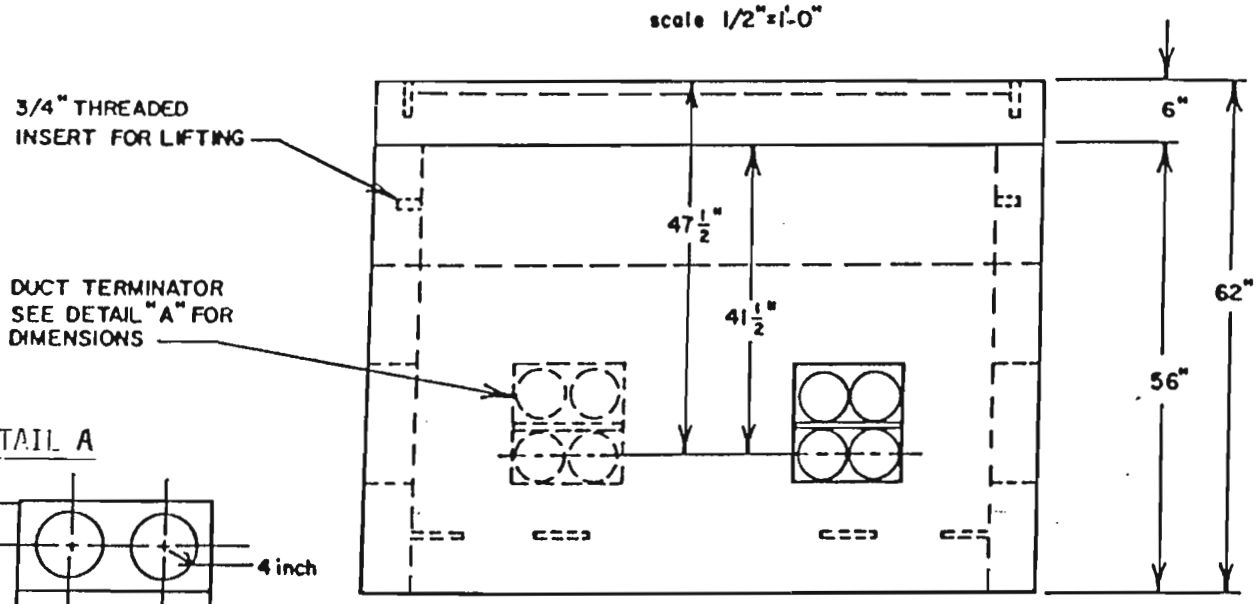
1. UG. SERVICES THAT ARE FED FROM ADJACENT LOTS SHALL CROSS THE SIDE PROPERTY LINE AS CLOSE TO THE REAR EDGE OF THE SIDEWALK AS POSSIBLE.
2. ALL METERS SHALL BE LOCATED ON THE FRONT QUARTER OF THE BUILDING ON THE SIDE APPROVED BY THE Town Building Inspector.
3. SERVICE CONDUCTORS SHALL BE RUN TO THE OUTSIDE EDGE OF THE SECONDARY HANDHOLE, PEDESTAL, OR TRANSFORMER WHICH IS NEAREST THE METER LOCATION INDICATED. THREE (3) FEET OF CABLE SHALL BE COILED ABOVE GRADE FOR TERMINATION BY Town.

METER LOCATION

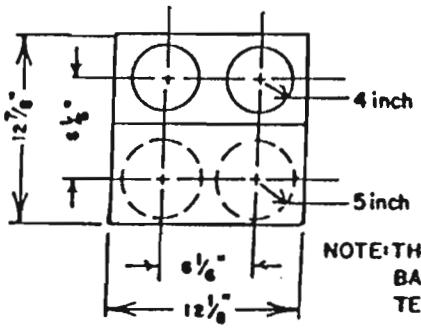
FIG 6-2



TOP VIEW
scale 1/2"=1'-0"



DETAIL A

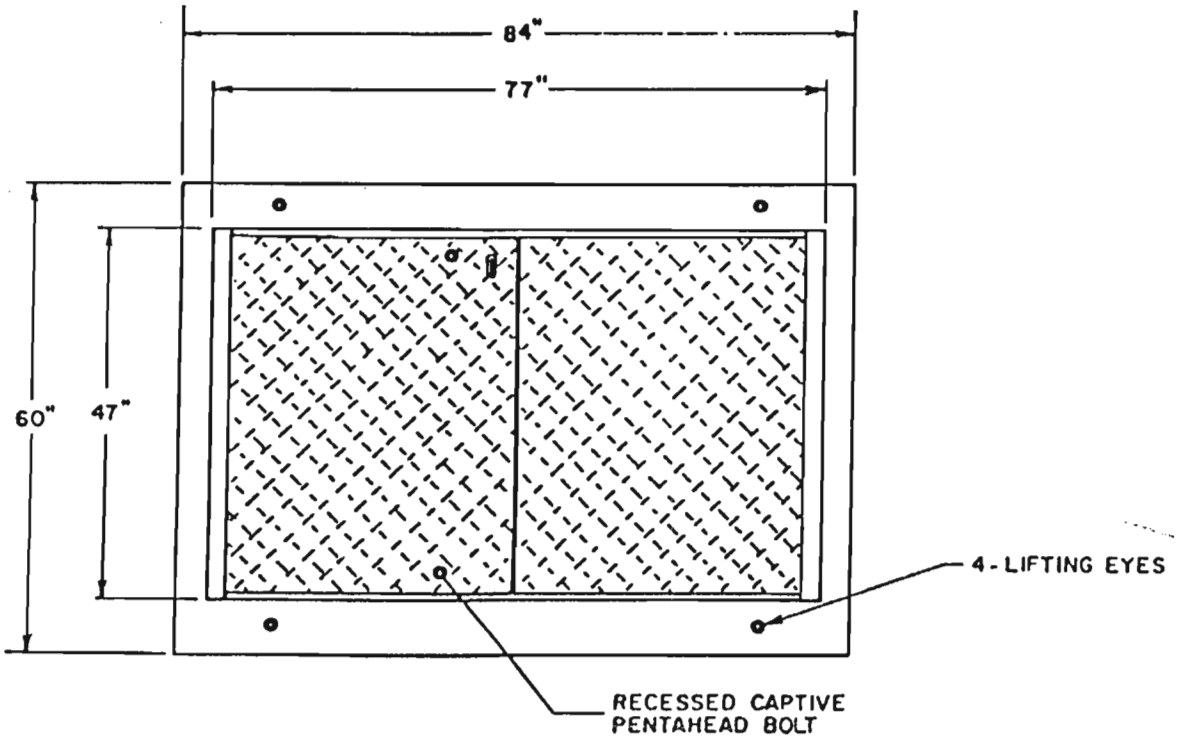


NOTE: THESE DIMENSIONS ARE BASED ON "FORMEX" DUCT TERMINATORS ONLY.

SIDE VIEW
scale 1/2"=1'-0"

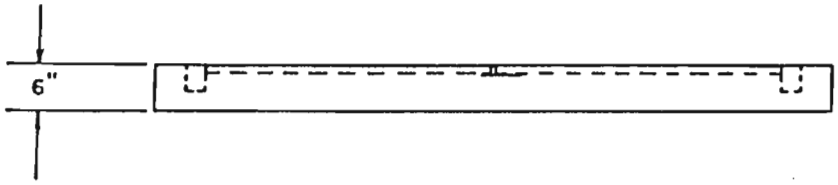
. VAULT DIMENSIONS

FIG 6-3



FRAME & COVER TOP VIEW

scale 1/2" = 1'-0"

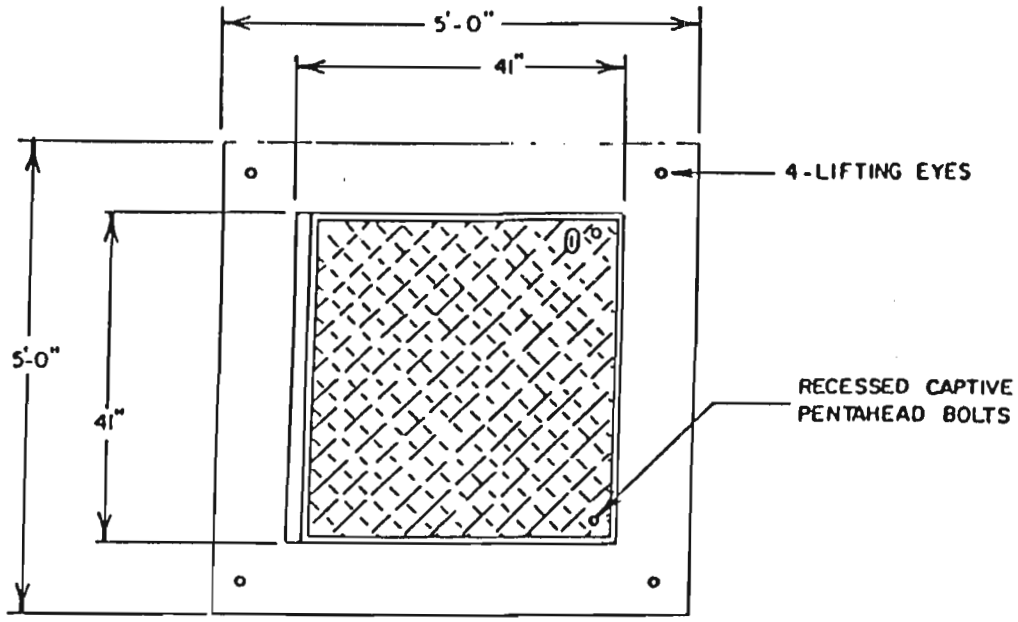


SIDE VIEW

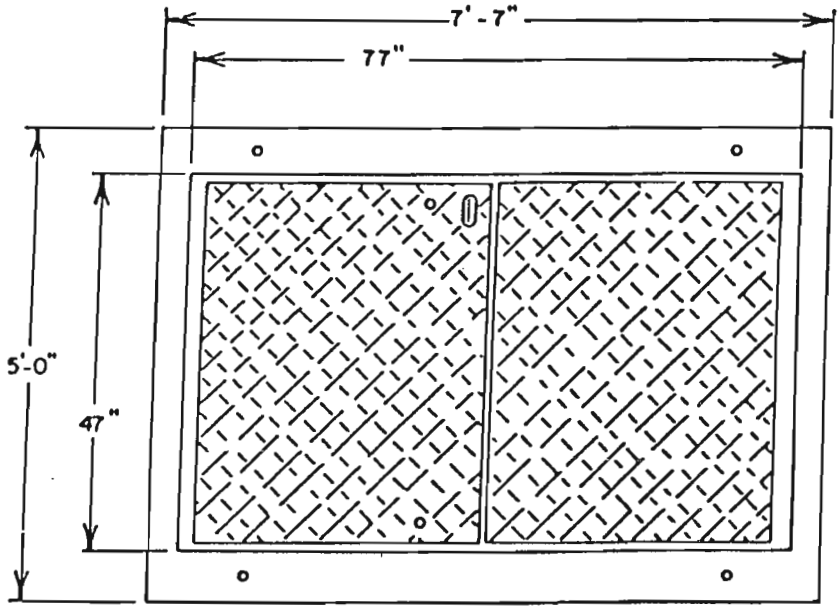
scale 1/2" = 1'-0"

VAULT FRAME AND COVER

FIG 6-4a



LID FOR 4'x4'x4'-8" VAULT

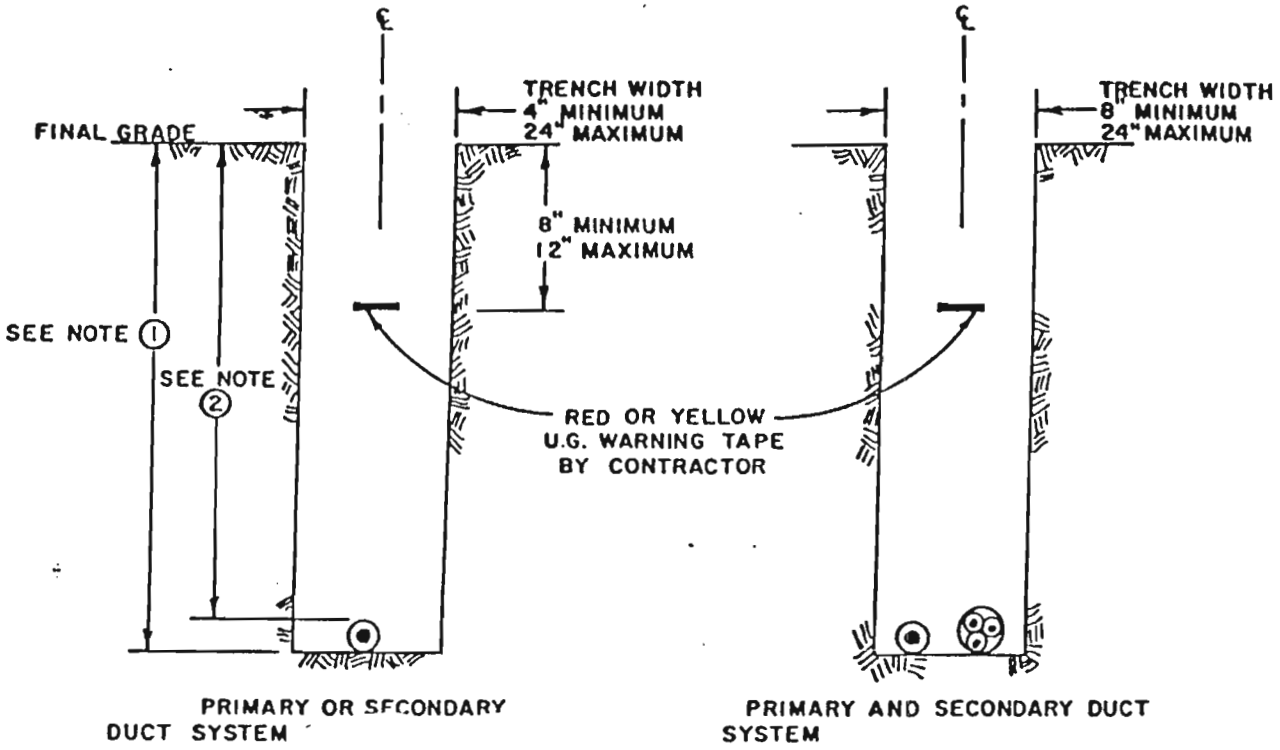


LID FOR 4'x6'x4x4'-6"VAULT

VAULT LIDS

FIG 6-4b

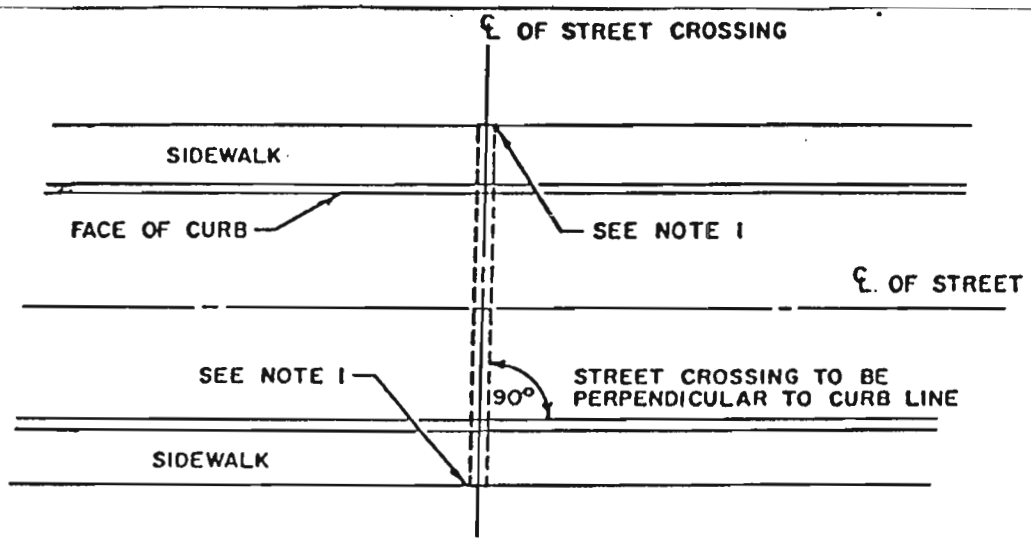
TYPICAL TRENCH CROSS-SECTION

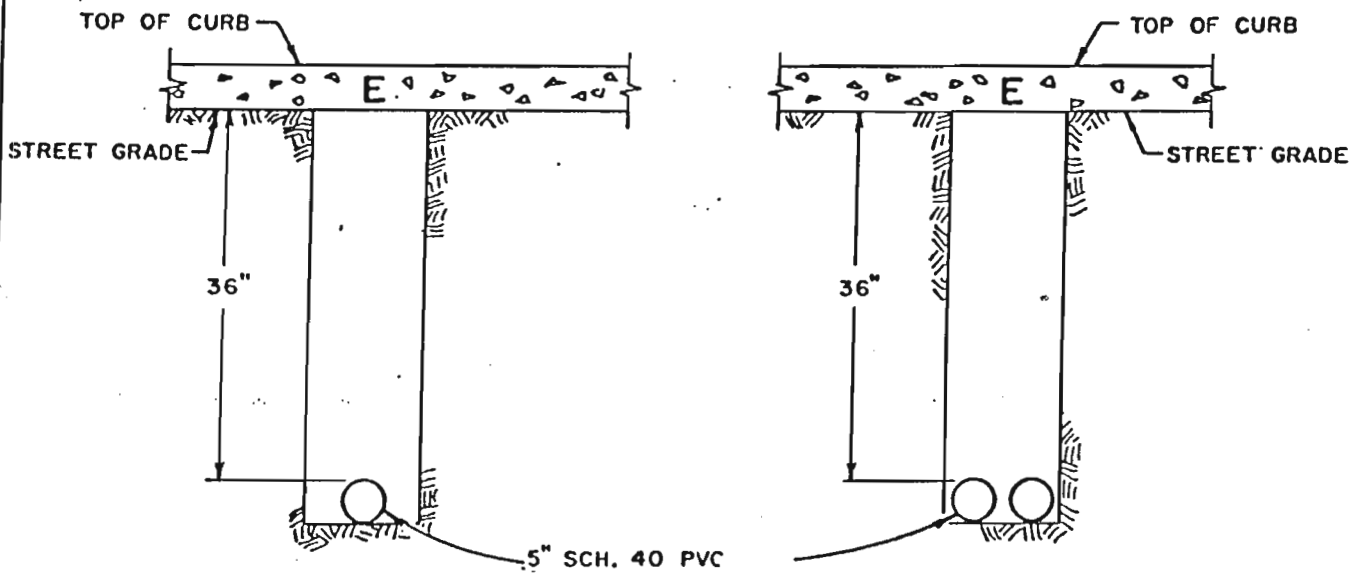


1. (A) RESIDENTIAL TRENCH DEPTH SHALL BE 42" MAXIMUM.
   (B) COMMERCIAL TRENCH DEPTH SHALL BE 48" MINIMUM.
2. RESIDENTIAL DUCT INSTALLATIONS SHALL BE A MINIMUM OF 36" BELOW FINAL GRADE.
3. ALL DUCT shall BE SCHEDULE 40 PVC
4. THE CONTRACTOR SHALL PASS A MANDREL WITH A DIAMETER 1/4 INCH LESS THAN THE INSIDE DIAMETER OF THE DUCT THROUGH EACH EMPTY DUCT RUN.
5. THE CONTRACTOR SHALL INSTALL A 1/4 INCH POLYPROPYLENE ROPE IN ALL EMPTY DUCTS.
6. ALL SCHEDULE 40 PVC SHALL BE DIRECT-BURIED. unless concrete encasement required.

TRENCH (PRIMARY AND SECONDARY)

FIG 6-5a

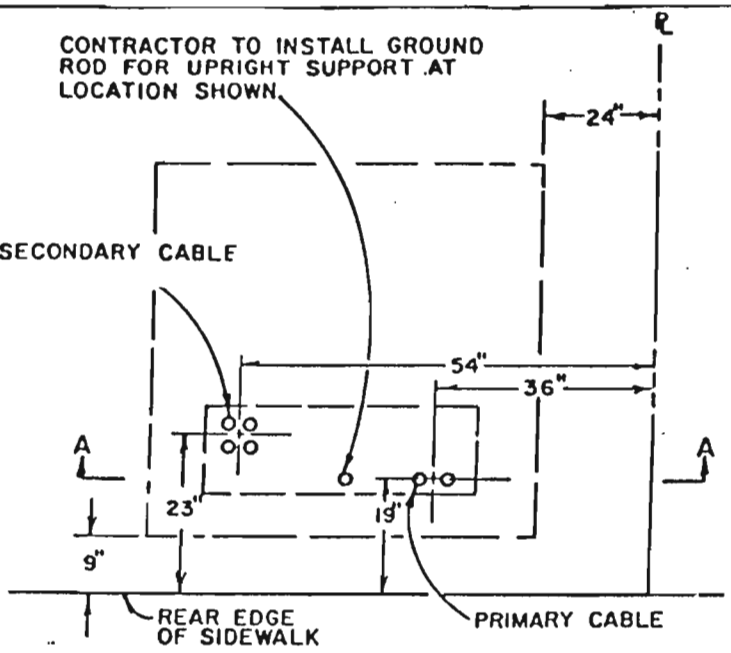


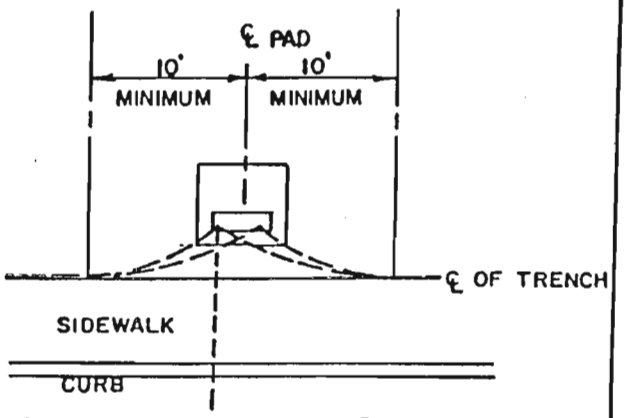


1. PVC SLEEVE TO TERMINATE AT REAR EDGE OF SIDEWALK (CENTERLINE OF CABLE TRENCH)
2. IF SLEEVE IS FOR FUTURE USE ONLY-CAP DUCT ENDS.
3. ON ALL STREET CROSSINGS, BOTH CURBS MUST BE MARKED WITH LETTER "E" CHISELED IN THE FACE OF EACH CURB ON ℄ WITH STREET CROSSING. LETTER "E" TO BE 2" HIGH, 1/8" DEEP AND PAINTED RED.

TRENCH STREET CROSSING

FIG 6-5b

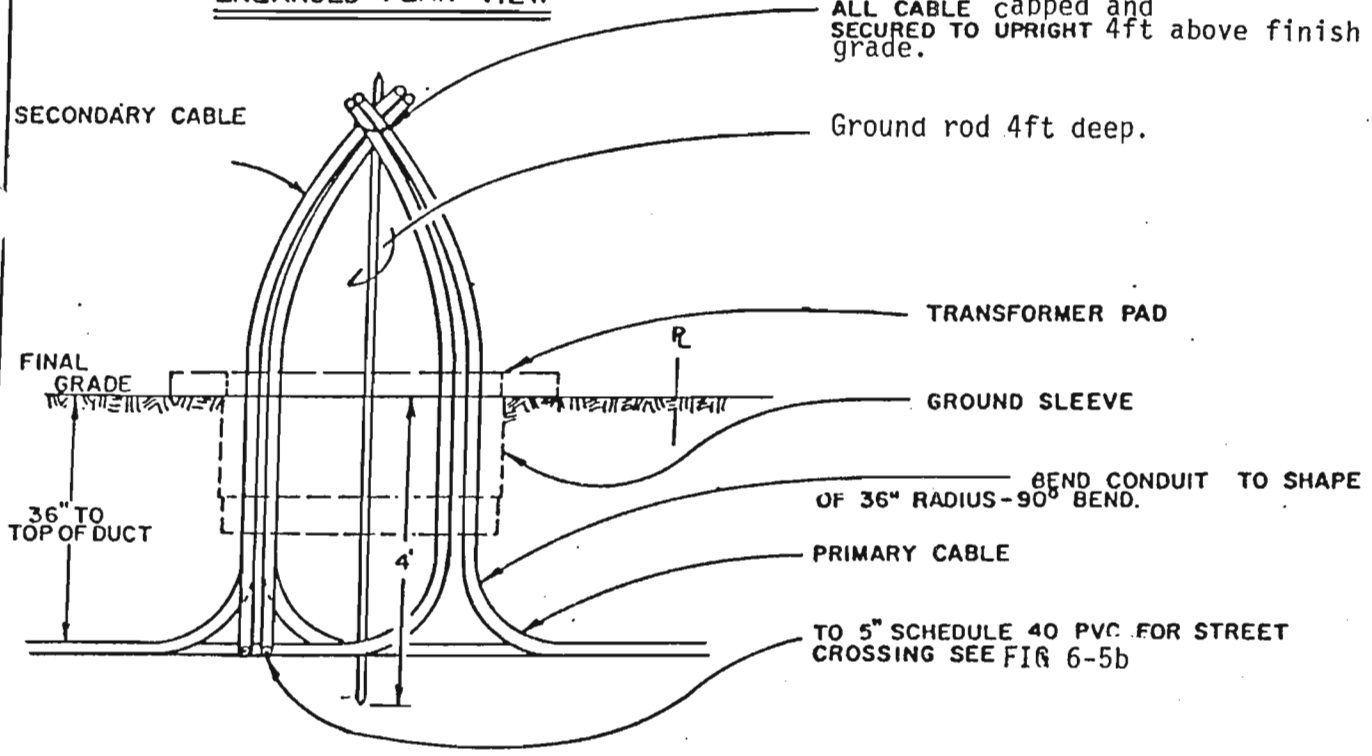




NOTE: CABLE TRANSITION FROM TRENCH TO PAD SHALL BEGIN NO FURTHER THAN 10' FROM CENTERLINE OF PAD.

PLAN VIEW

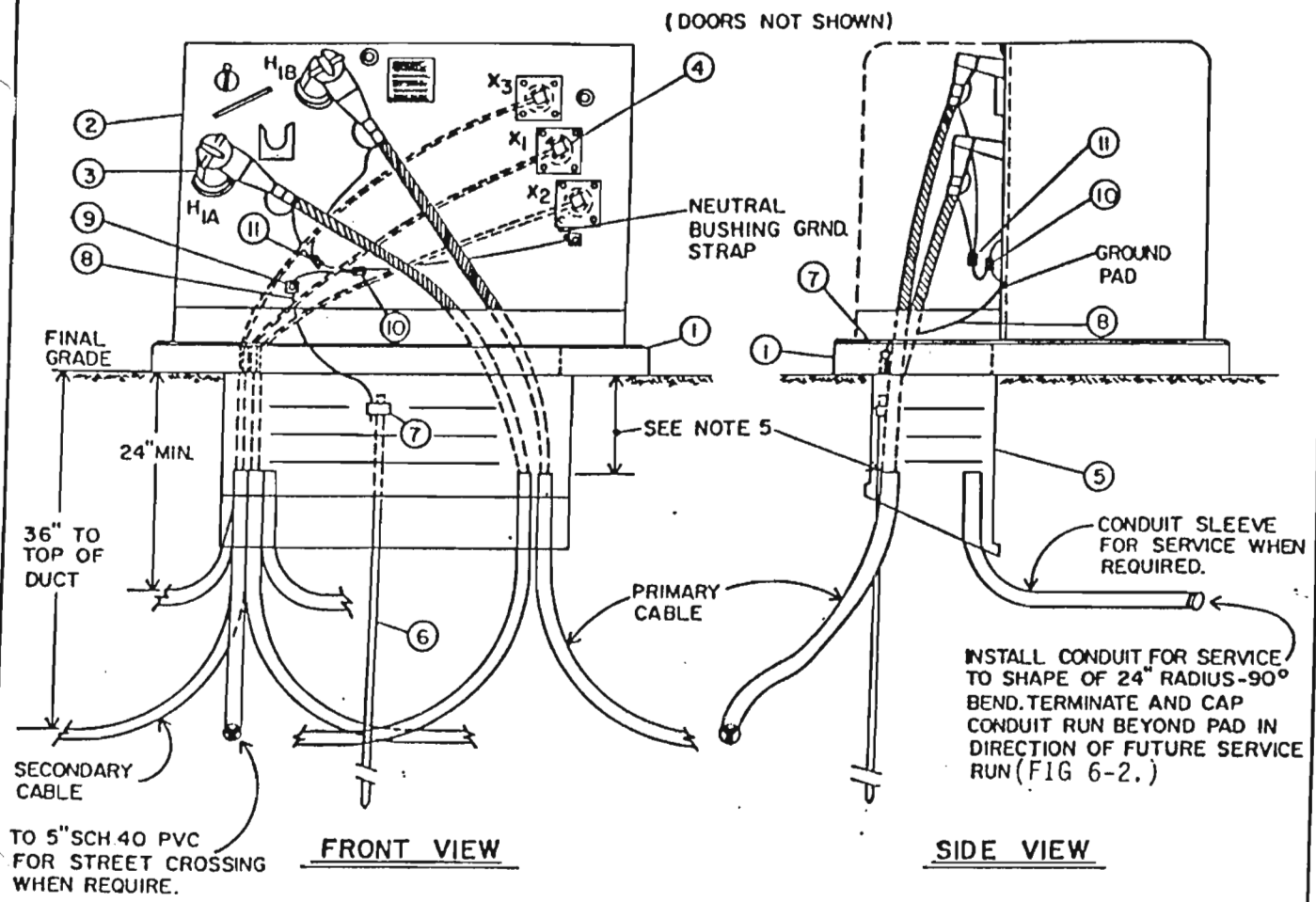
ENLARGED PLAN VIEW



SECTION A-A

TRANSFORMER INSTALLATION

FIG 6-6a



INSTALLATION NOTES:

1. TRAIN PRIMARY CABLE AND CONCENTRIC NEUTRAL AS NECESSARY SO SUFFICIENT SLACK IS PROVIDED FOR ELBOW OPERATION AND PARKING WITHOUT DISCONNECTING THE NEUTRALS.
2. INSTALL SECONDARY CABLE BEHIND PRIMARY CABLE.
3. #4 CU GROUND WIRE TO BE CONTINUOUS FROM NEUTRAL BUSHING TANK GROUND THRU PRIMARY SIDE TANK GROUND TO GROUND ROD CLAMP.
4. USE HAREWARE FURNISHED WITH PAD TO ANCHOR TRANSFORMER.
5. REMOVE CONDUIT 9"-11" BELOW FINAL GRADE
6. EARTH AROUND GROUND SLEEVE AND BELOW TRANSFORMER PAD SHALL BE COMPACTED TO 90% OF Standard Proctor.
7. INSTALL CONDUIT SLEEVES FOR SERVICE WHEN TRANSFORMER FEEDS HOUSES DIRECTLY. CONTRACTOR SHALL COORDINATE EXTENSION AND TERMINATION OF SERVICE TO TRANSFORMER WITH CITY ELECTRIC DEPARTMENT.

TRANSFORMER WIRING CONNECTIONS

FIG 6-6b

MATERIAL LIST

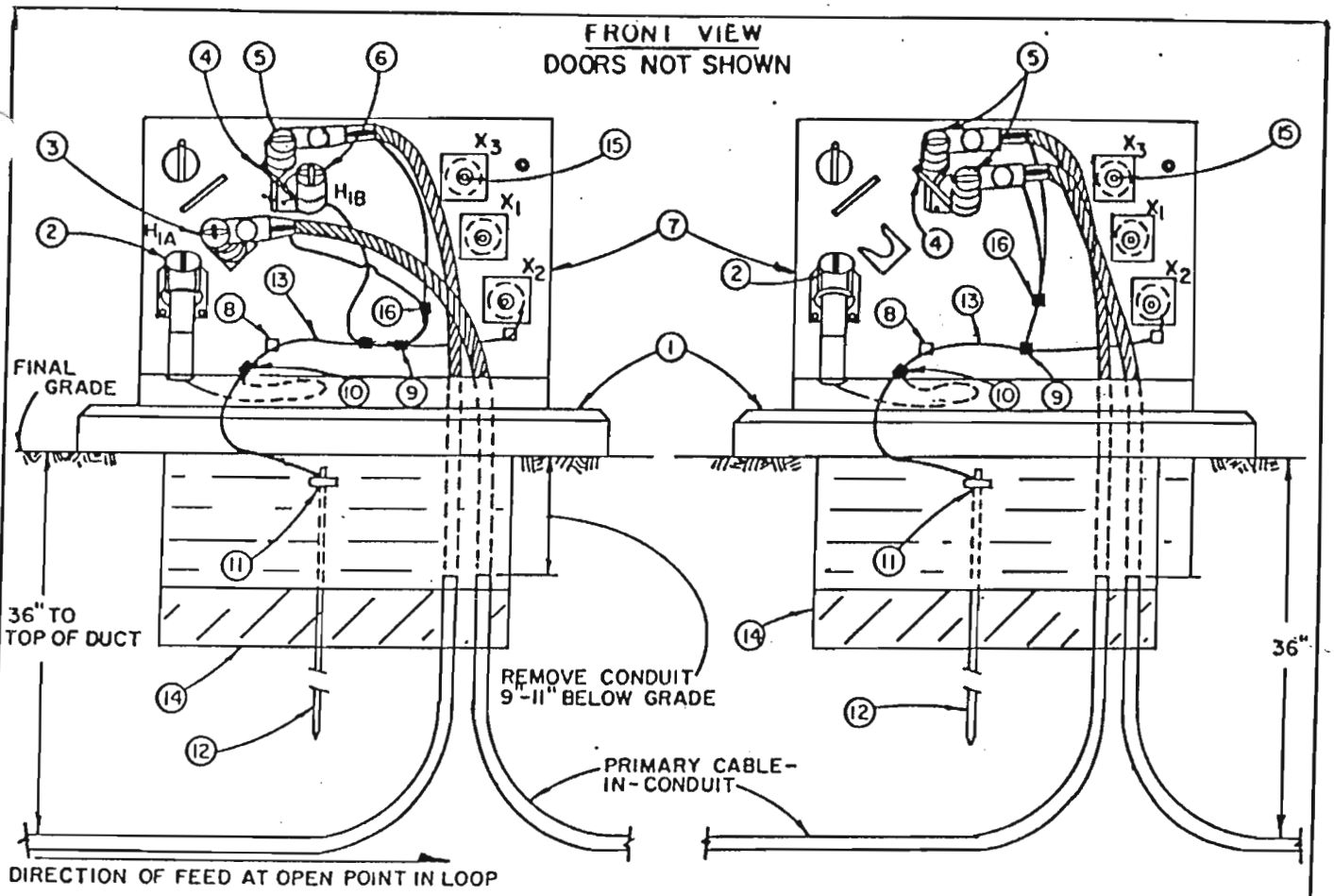
ITEM	STOCK NO.	FILE NO.	MATERIAL DESCRIPTION	QUANTITY								UNIT	DETAIL NO.
				A	B	C	D	E	F	G	H		
1	108 - 340	196	PAD, 1Ø TRANSFORMER	1	1	1	1	1	1	1	1	EA.	6-2
2	*		TRANSFORMER, 1Ø PADMOUNT - 25 KVA	1				1				EA.	
	*		TRANSFORMER, 1Ø PADMOUNT - 50 KVA		1				1			EA.	
	*		TRANSFORMER, 1Ø PADMOUNT - 75 KVA			1				1		EA.	
	*		TRANSFORMER, 1Ø PADMOUNT - 100 KVA				1				1	EA.	
3	237 - 199	680	ELBOW, 15 KV LOADBREAK	2	2	2	2	1	1	1	1	EA.	6-4
4	241 - 719	946	CONNECTOR, 6 COND. SEC. (#6 - 350MCM)	3	3	3		3	3	3		EA.	6-14
	241 - 723	1003	CONNECTOR, 6 COND. SEC. (#6 - 500MCM)				3				3	EA.	6-14
5	108 - 346	162	GROUND SLEEVE	1	1	1	1	1	1	1	1	EA.	6-3
6	191 - 025	387	GROUND ROD, 5/8" x 8'	1	1	1	1	1	1	1	1	EA.	
7	241 - 487	909	CLAMP, COPPERCLAD GROUND ROD	1	1	1	1	1	1	1	1	EA.	
8	101 - 358	54	WIRE, #4 Cu. SOFT DRAWN	4	4	4	4	4	4	4	4	FT.	
9	241 - 811	976	CLAMP, TRANSFORMER TANK GROUND	2	2	2	2	2	2	2	2	EA.	
10	226-589	548	CONNECTOR, Cu. (#4 - 1/0)	1	1	1	1	1	1	1	1	EA.	
11	226-588	549	CONNECTOR, Cu. (1/0 - 1/0)	1	1	1	1					EA.	
12	237-194	676	CAP, INSULATED PROTECTIVE					1	1	1	1	EA.	6-6

* STOCK NO. FOR THIS ITEM NOT AVAILABLE

TRANSFORMER MATERIAL LIST
FIG 6-6b CONT

MATERIAL NOTES

A. 25 KVA LOOP FEED
B. 50 KVA LOOP FEED
C. 75 KVA LOOP FEED
D. 100 KVA LOOP FEED
E. 25 KVA RADIAL FEED
F. 50 KVA RADIAL FEED
G. 75 KVA RADIAL FEED
H. 100 KVA RADIAL FEED



CONFIGURATION "A"

TRANSFORMER AT THE NORMALLY OPEN POINT OF THE LOOP.

CONFIGURATION "B"

LAST TRANSFORMER THAT ENERGIZES THE CABLE FEEDING TO THE STANDOFF INSULATOR LOCATED IN CONFIGURATION "A" AT THE NORMALLY OPEN POINT OF THE LOOP.

INSTALLATION NOTES:

1. BOTH TRANSFORMER CONFIGURATIONS WITH M.O.V. ELBOW SURGE ARRESTOR SHALL BE ENERGIZED AT H_{1B} BUSHINGS.
2. TRAIN PRIMARY CABLE & CONCENTRIC NEUTRAL AS NECESSARY SO SUFFICIENT SLACK IS PROVIDED FOR ELBOW OPERATION AND PARKING WITHOUT DISCONNECTING THE NEUTRALS.
3. INSTALL SECONDARY CABLE BEHIND PRIMARY CABLE.
4. NO. 4 Cu GROUND WIRE TO BE CONTINUOUS FROM NEUTRAL BUSHING TANK GROUND THRU PRIMARY SIDE TANK GROUND TO GROUND ROD CLAMP.
5. USE HARDWARE FURNISHED WITH PAD TO ANCHOR TRANSFORMER.
6. REMOVE CONDUIT 9"-11" BELOW FINAL GRADE (SHOWN ABOVE).
7. EARTH AROUND GROUND SLEEVE AND BELOW TRANSFORMER PAD SHALL BE COMPACTED TO 90% OF
8. INSTALL CONDUIT SLEEVES FOR SERVICES WHEN TRANSFORMER FEEDS HOUSES DIRECTLY. CONTRACTOR SHALL COORDINATE EXTENSION AND TERMINATION OF SERVICE TO TRANSFORMER WITH CITY ELECTRIC DEPARTMENT.
9. SEE FIG 6-6b FOR SECONDARY CONDUCTOR INSTALLATION CONFIGURATION.

TRANSFORMER WIRING CONNECTIONS
OPEN POINT IN LOOP

FIG 6-6c

MATERIAL LIST

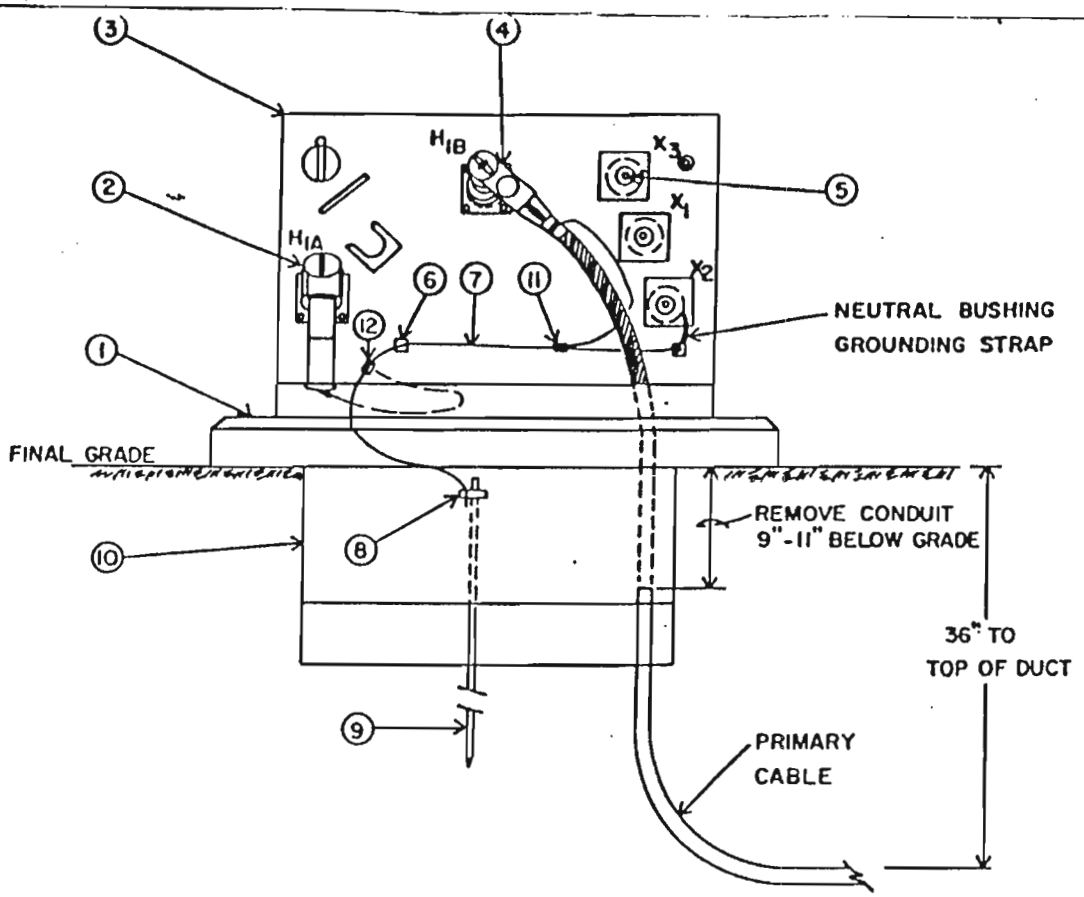
ITEM	STOCK NO.	FILE NO.	MATERIAL DESCRIPTION	QUANTITY								UNIT	DETAIL NO.
				A	B	C	D	E	F	G	H		
1	108-340	196	PAD, 1Ø TRANSFORMER	1	1	1	1	1	1	1	1	EA.	6-2
2	151-094	321	ARRESTOR, 15 KV M.O.V. ELBOW SURGE	1	1	1	1	1	1	1	1	EA.	
3	237-228	707	INSULATOR, 15 KV STANDOFF	1	1	1	1					EA.	6-5
4	237-791	793	INSERT, DUAL BUSHING FEEDTHRU	1	1	1	1	1	1	1	1	EA.	
5	237-199	680	ELBOW, 15 KV LOADBREAK	2	2	2	2	2	2	2	2	EA.	6-4
6	237-194	676	CAP, INSULATED PROTECTIVE	1	1	1	1					EA.	6-6
7	*		TRANSFORMER, 1Ø PADMOUNT-25 KVA	1				1				EA.	
	*		TRANSFORMER, 1Ø PADMOUNT-50 KVA		1				1			EA.	
	*		TRANSFORMER, 1Ø PADMOUNT-75 KVA			1				1		EA.	
	*		TRANSFORMER, 1Ø PADMOUNT-100 KVA				1				1	EA.	
8	241-811	976	CLAMP, TRANSFORMER TANK GROUND	2	2	2	2	2	2	2	2	EA.	
9	226-589	548	CONNECTOR, Cu. (#4 - 1/0)	1	1	1	1	1	1	1	1	EA.	
10	226-585	545	CONNECTOR, Cu. (#4 - #4)	2	2	2	2	1	1	1	1	EA.	
11	241-487	909	CLAMP, COPPERCLAD GROUND ROD	1	1	1	1	1	1	1	1	EA.	
12	191-025	387	GROUND ROD, 5/8" x 8'	1	1	1	1	1	1	1	1	EA.	
13	101-358	54	WIRE, #4 Cu. SOFT DRAWN	4	4	4	4	4	4	4	4	FT.	
14	108-346	162	GROUND SLEEVE	1	1	1	1	1	1	1	1	EA.	6-3
15	241-719	946	CONNECTOR, 6 COND. SEC. (#6-350MCM)	3	3	3		3	3	3		EA.	6-14
	241-723	1003	CONNECTOR, 6 COND. SEC. (#6-500MCM)				3				3	EA.	6-14
16	226-588	549	CONNECTOR, Cu. (1/0 - 1/0)	1	1	1	1	1	1	1	1	EA.	

* STOCK NO. FOR THIS ITEM NOT AVAILABLE

TRANSFORMER MATERIAL LIST
FIG 6-6c CONT

MATERIAL NOTES

A. 25 KVA CONFIGURATION A
B. 50 KVA CONFIGURATION A
C. 75 KVA CONFIGURATION A
D. 100 KVA CONFIGURATION A
E. 25 KVA CONFIGURATION B
F. 50 KVA CONFIGURATION B
G. 75 KVA CONFIGURATION B
H. 100 KVA CONFIGURATION B



FRONT VIEW
(DOOR NOT SHOWN)

INSTALLATION NOTES:

1. TRANSFORMER AT END OF RADIAL WITH M.O.V. ELBOW SURGE ARRESTOR SHALL BE ENERGIZED AT H_{1B} BUSHING.
2. TRAIN PRIMARY CABLE AND CONCENTRIC NEUTRAL AS NECESSARY SO SUFFICIENT SLACK IS PROVIDED FOR ELBOW OPERATION AND PARKING WITHOUT DISCONNECTING THE NEUTRALS.
3. INSTALL SECONDARY CABLE BEHIND PRIMARY CABLE.
4. #4 CU GROUND WIRE TO BE CONTINUOUS FROM NEUTRAL BUSHING TANK GROUND THRU PRIMARY SIDE TANK GROUND TO GROUND ROD CLAMP.
5. USE HARDWARE FURNISHED WITH PAD TO ANCHOR TRANSFORMER.
6. REMOVE CONDUIT 9"-11" BELOW FINAL GRADE (SHOWN ABOVE).
7. EARTH AROUND GROUND SLEEVE AND BELOW TRANSFORMER PAD SHALL BE COMPACTED TO 90% OF Standard Proctor.
8. INSTALL CONDUIT SLEEVES FOR SERVICES WHEN TRANSFORMER FEEDS HOUSES DIRECTLY. CONTRACTOR SHALL COORDINATE EXTENSION AND TERMINATION OF SERVICE TO TRANSFORMER WITH CITY ELECTRIC DEPARTMENT.
9. SEE FIG 6-6b FOR SECONDARY CONDUCTOR INSTALLATION CONFIGURATION.

TRANSFORMER WIRING CONNECTIONS
END OF RADIAL

FIG 6-6d

MATERIAL LIST

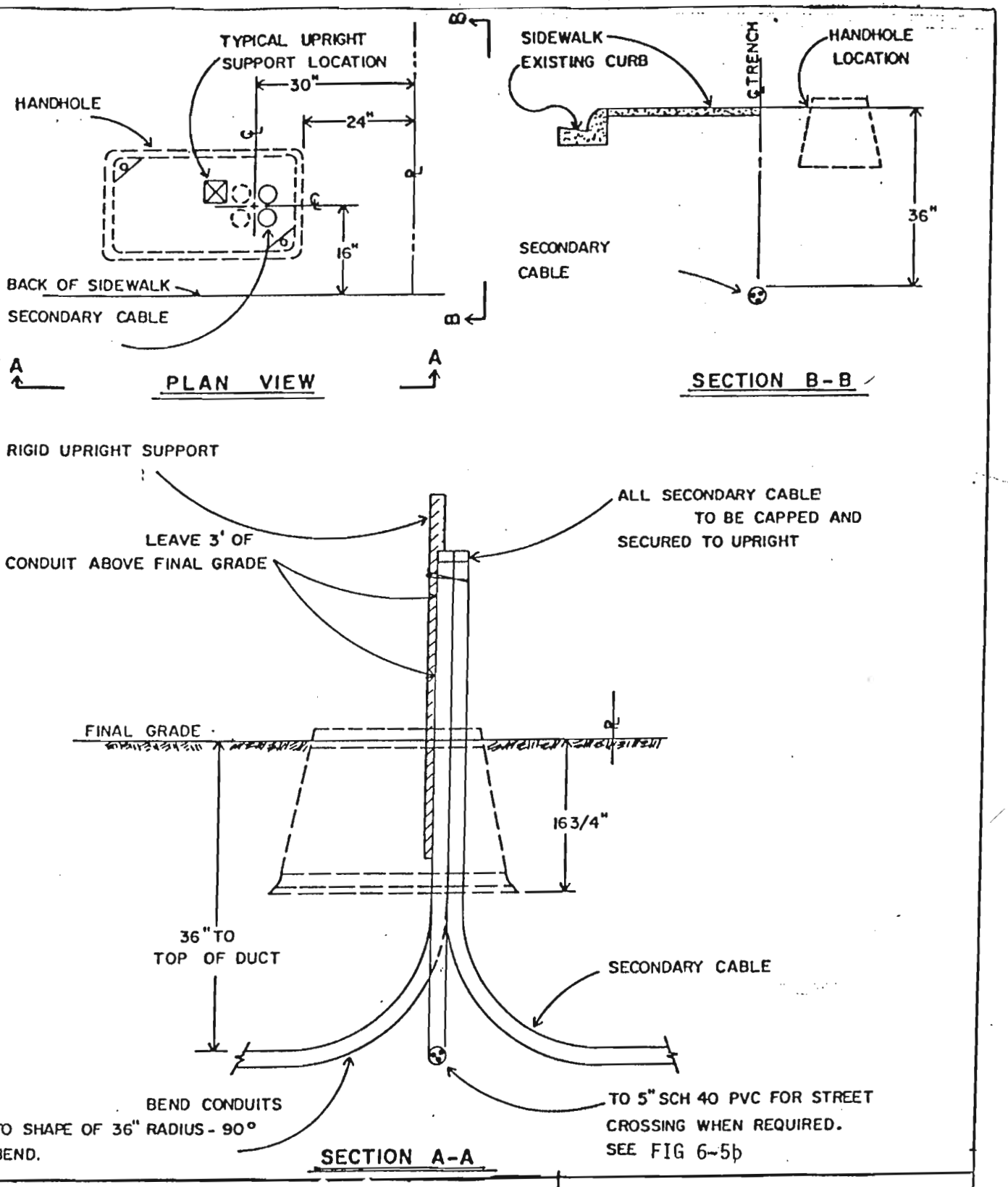
ITEM	STOCK NO.	FILE NO.	MATERIAL DESCRIPTION	QUANTITY A	B	C	D					UNIT	DETAIL NO.
1	108 - 340	196	PAD, 1Ø TRANSFORMER	1	1	1	1					EA.	6-2
2	151 - 094	321	ARRESTOR, 15 KV M.O.V. ELBOW SURGE	1	1	1	1					EA.	
3	*		TRANSFORMER, 1Ø PADMOUNT - 25 KVA	1								EA.	
	*		TRANSFORMER, 1Ø PADMOUNT - 50 KVA		1							EA.	
	*		TRANSFORMER, 1Ø PADMOUNT - 75 KVA			1						EA.	
	*		TRANSFORMER, 1Ø PADMOUNT - 100 KVA				1					EA.	
4	237 - 199	680	ELBOW, 15 KV LOADBREAK	1	1	1	1					EA.	6-4
5	241 - 719	946	CONNECTOR, 6 COND. SEC. (#6 - 350MCM)	1	1	1						EA.	6-14
	241 - 723	1003	CONNECTOR, 6 COND. SEC. (#6 - 500MCM)				1					EA.	6-14
6	241 - 811	976	CLAMP, TRANSFORMER TANK GROUND	2	2	2	2					EA.	
7	101 - 358	54	WIRE, #4 Cu. SOFT DRAWN	4	4	4	4					FT.	
8	241 - 487	909	CLAMP, COPPERCLAD GROUND ROD	1	1	1	1					EA.	
9	191 - 025	387	GROUND ROD, 5/8" x 8'	1	1	1	1					EA.	
10	108 - 346	162	GROUND SLEEVE	1	1	1	1					EA.	6-3
11	226 - 589	548	CONNECTOR, Cu. (#4 - 1/0)	1	1	1	1					EA.	
12	226 - 585	545	CONNECTOR, Cu. (#4 - #4)	1	1	1	1					EA.	

* STOCK NO. FOR THIS ITEM NOT AVAILABLE

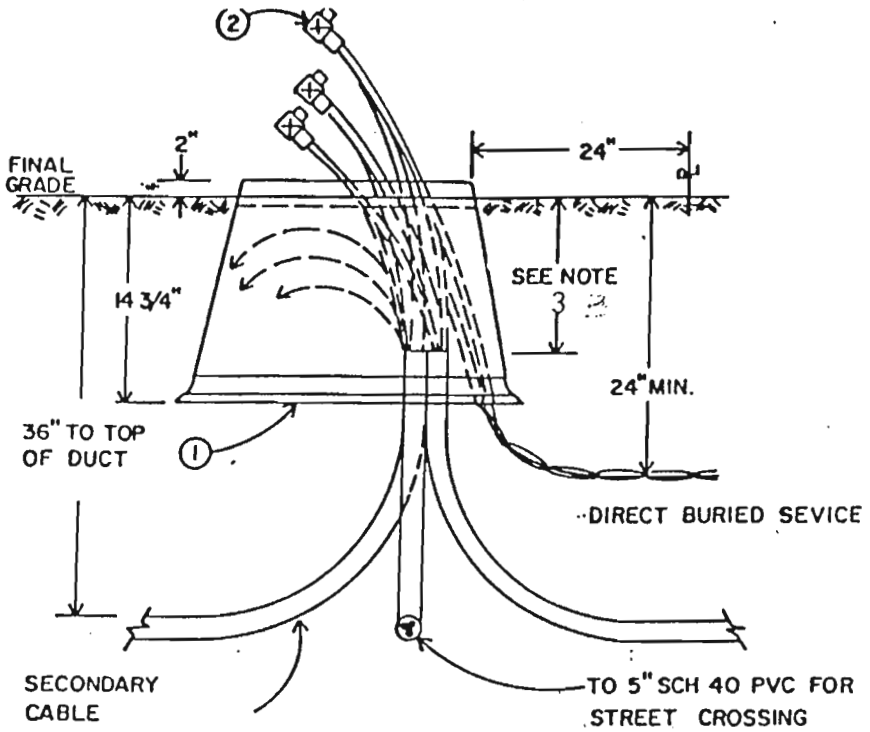
TRANSFORMER MATERIAL LIST
FIG 6-6d CONT

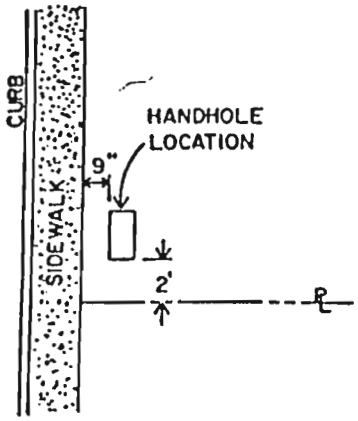
MATERIAL NOTES

A. 25 KVA TRANSFORMER
B. 50 KVA TRANSFORMER
C. 75 KVA TRANSFORMER
D. 100 KVA TRANSFORMER



HANDHOLE INSTALLATION
FIG 6-7 a





INSTALLATION NOTES:

1. TOP OF HANDHOLE TO BE 2" ABOVE FINAL GRADE ON ALL SIDES.
2. EARTH AROUND HANDHOLE TO BE FIRMLY TAMPED.
3. REMOVE CONDUIT 10"-12" BELOW FINAL GRADE.
4. CONTRACTOR TO RUN SERVICE TO OUTSIDE EDGE OF HANDHOLE AND LEAVE 3 FEET OF CABLE COILED ABOVE GRADE FOR TERMINATION

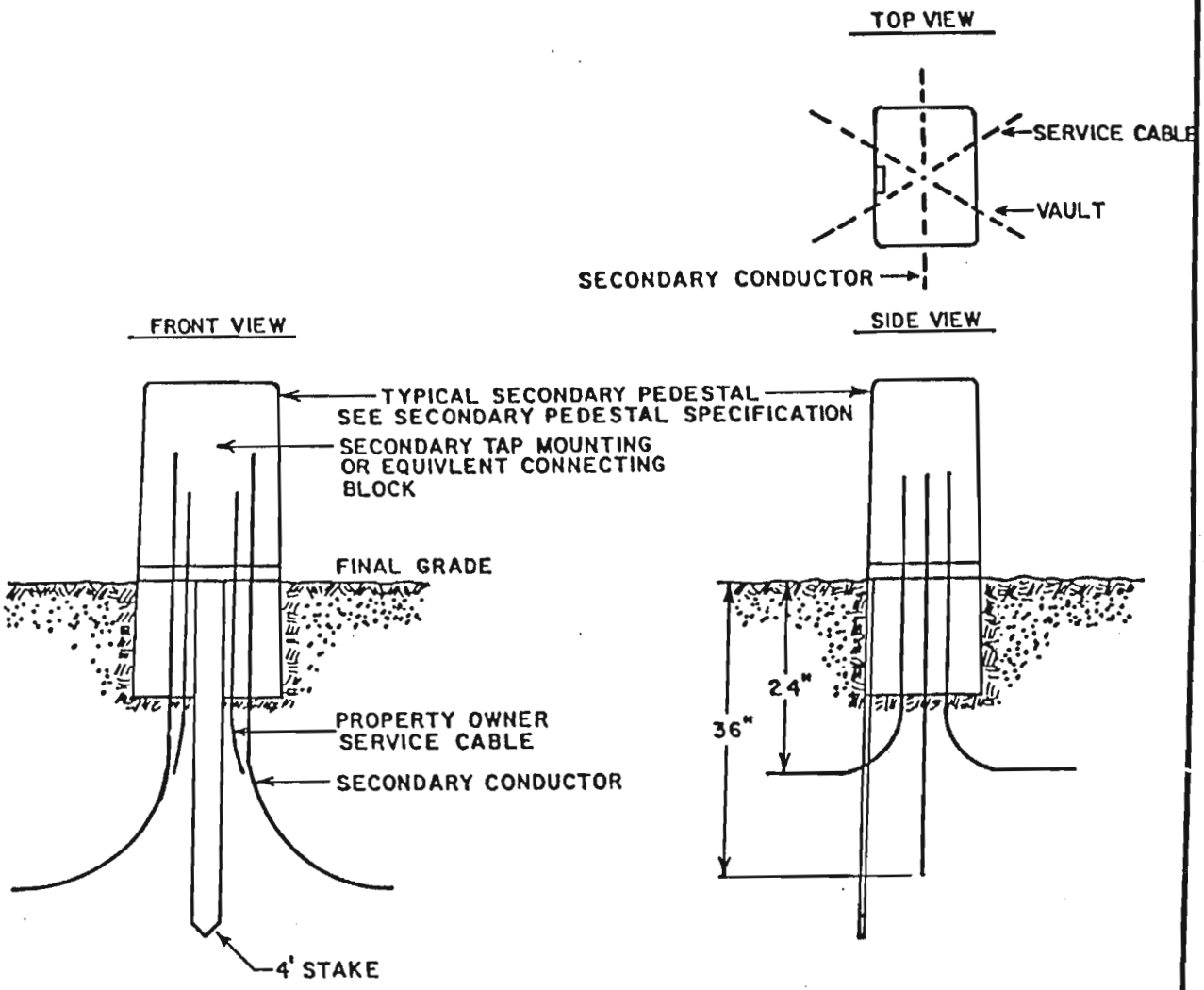
MATERIAL LIST

ITEM	STOCK NO	FILE NO.		QUANTITY A	QUANTITY B	UNIT	DETAIL NO.
1	237-243	719	HANDHOLE, U.G. SECONDARY	1	1	EA	6-16
2	241-721	948	CONNECTOR, U.G. SEC-4 CONDUCTOR	3		EA	6-12
2	241-722	999	CONNECTOR, U.G. SEC-6 CONDUCTOR		3	EA	6-12

MATERIAL NOTES:

A. 4 CONDUCTOR CONNECTOR.
B. 6 CONDUCTOR CONNECTOR.

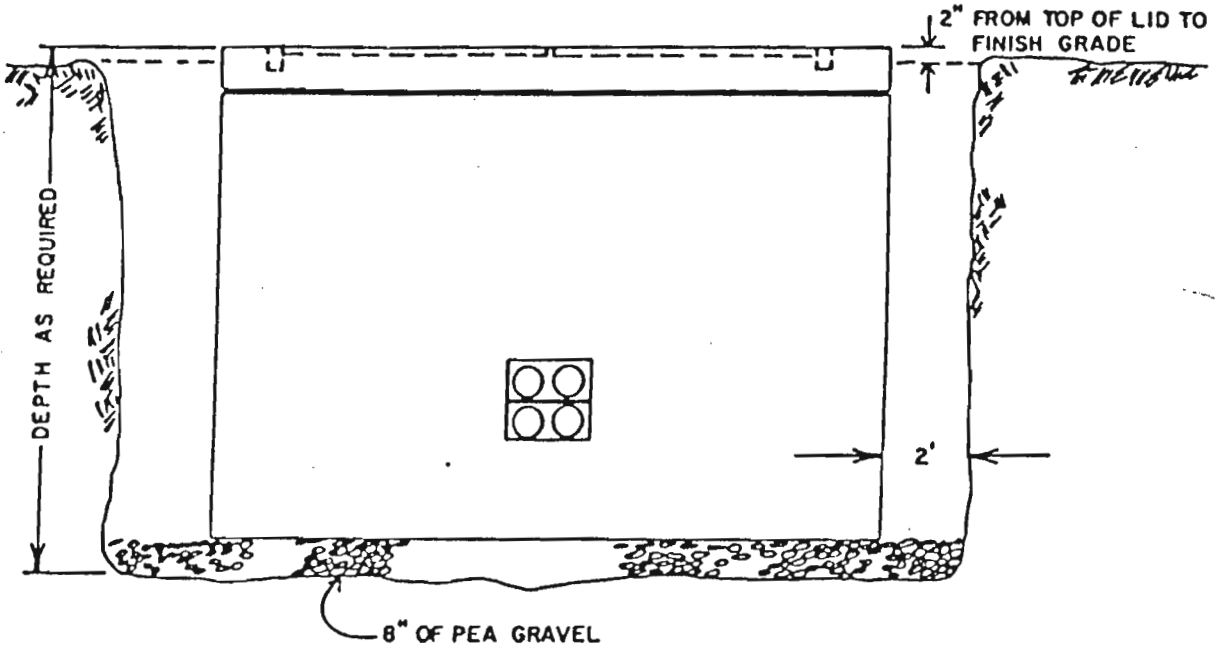
HANDHOLE WIRING CONNECTIONS
FIG 6-7b



NOTE:
DIMENSIONS SHOWN ARE MINIMUM.

PEDESTAL INSTALLATION

FIG 6-8



TO BE EXCAVATED 2' AROUND ALL SIDES TO ENSURE PROPER ROOM FOR TAMPING.

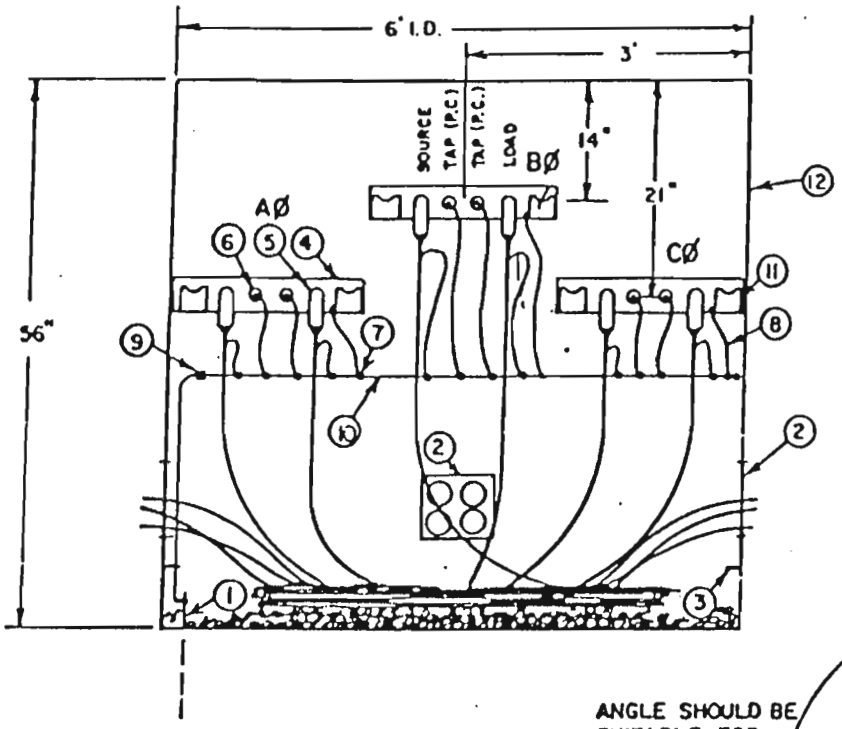
*FINAL COMPACTION SHOULD BE TO 90% OF

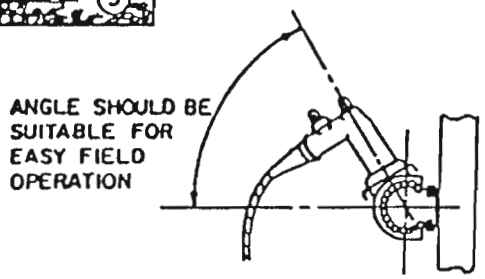
NOTE: 1. THIS SPECIFICATION APPLIES TO THE INSTALLATION OF ALL VAULTS.

2. IF VAULT IS TO BE PLACED IN SIDEWALK, ALONG CURB OR OTHER PAVED AREAS, KEEP TOP OF LID LEVEL WITH FINISHED GRADE.

VAULT INSTALLATION

FIG 6-9a





MOUNTING DETAIL

NOTE:

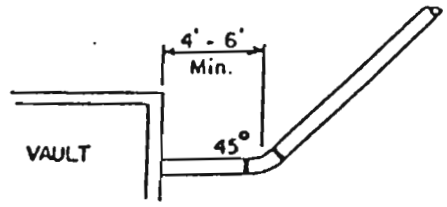
1. THIS IS A TYPICAL INSTALLATION TO BE USED WITH 2, 3, AND 4 POSITION MODULES - 200 AMP
2. IF 45° ANGLE CONDUIT BENDS ARE CALLED FOR OR NEEDED AS DUCT LEAVES THE VAULT, A MINIMUM STRAIGHT LENGTH OF 4' to 6' OF CONDUIT SHALL BE INSTALLED PRIOR TO TURNING THE ANGLE.
3. A MINIMUM OF 12' OF CABLE PER PHASE SHALL BE LOOPED IN VAULT
4. FOR 1Ø MODULE INSTALLATION, PLACE MODULE AT DESIGNATED LOCATION SHOWN ABOVE FOR THE PARTICULAR PHASE USED. (EX. - CØ MODULE SHOULD BE MOUNTED ON RIGHT SIDE OF WALL.)

VAULT WIRING CONNECTIONS

FIG 6-9b

QUANTITIES : A = 2 POSITION MODULE
B = 3 POSITION MODULE
C = 4 POSITION MODULE

ITEM	QTY A	QTY B	QTY C	DETAIL NO.	MATERIAL DESCRIPTION
1	1	1	1		5/8" x 8' GROUND ROD AND GROUND ROD CLAMP. 4" TO 6" FROM WALL, LOCATION AS SHOWN. (SEE GROUND ROD SPEC.)
2	1	1	1		4 - 4" DUCT TERMINATORS, EACH SIDE
3	1	1	1		PULLING EYES BELOW EACH TERMINATOR
4	1	1	1	6-7	15KV MODULE, 200a, AS REQUIRED. (SEE MODULE SPECIFICATION.)
5	2	3	4	6-4	8.3/14.4 KV ELBOW, 200a (SEE ELBOW SPECIFICATION)
6				6-6	15KV PROTECTIVE CAP, 200a (SEE CAP SPECIFICATION)
7	13	13	13		Cu. COMPRESSION CONNECTOR
8	20'	20'	20'		#2 SOLID Cu. GROUND WIRE TO MODULES
9	4	4	4		CAST CLAMP TO HOLD GROUND WIRE TO WALL OF VAULT
10	20'	20'	20'		GROUND WIRE (SEE Cu GROUND WIRE SPECIFICATION)
11	6	6	6		RAWL STUD 1/2" x 2 3/4" FOR MODULE SUPPORT
12	1	1	1		4' x 6' x 4'-8" ELECTRIC VAULT (SEE VAULT SPEC.)



CONDUIT DETAIL
top view

VAULT MATERIAL LIST
FIG 6-9b CONT

WARNING TAPE

Application: Buried cable installation

Description:

Stock No.	Color	Roll Width	Roll Length	Polyethylene Thickness	Legend
237-185	Red or yellow	6"	1,000'	.004"	"Buried Electric Line Below"

Manufacturers Data:

Stock No.	Catalogue No.
237-185	Al-6100-RE (Alarmoline)

DETAIL 6-1

GROUND SLEEVES

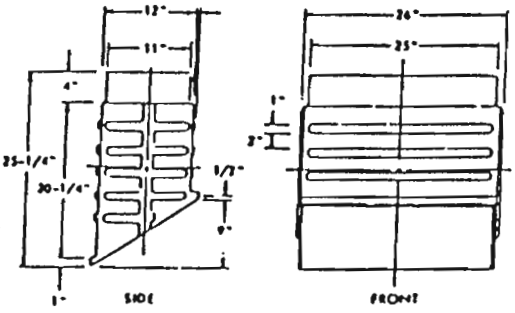
Application: Cable training under single phase padmounted transformers.

Description:

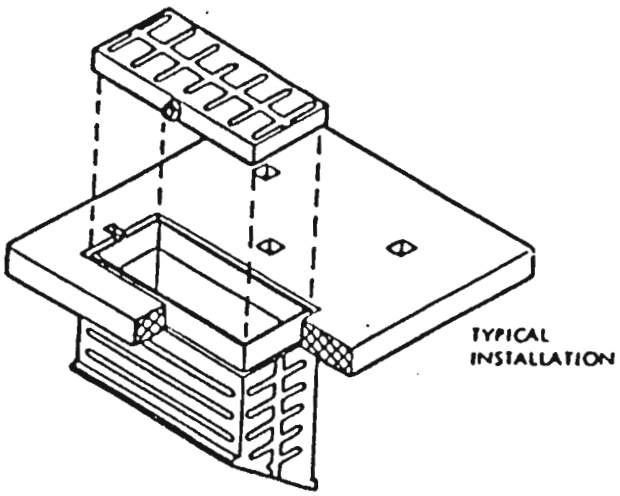
Stock No.	Overall O.D. (L x W x H)	Pad Opening Required
108-346	26" x 12" x 25 1/4"	12" x 26"

Manufacturers Data:

Stock No.	Catalogue No.
108-346	VS-1 (Thermodynamics Corp.)



VAULT-SCOOP



DETAIL 6-3

LOADBREAK ELBOWS (200 amp)

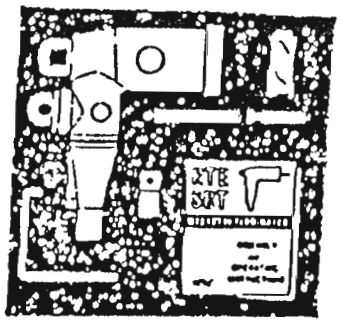
Application: Termination of 15KV underground primary cable (Note: capacitive test point requires special potential indicator)

Description: Use copper top wire connectors only.

Stock No.	Voltage Rating	Cable Conductor	Insulation O.D.(±.030)	Test Point	Burndy Die Index
237-200	14.4KV	#2 - 7	0.695"	Yes	BG,243
237-199	14.4KV	1/0 - 19	0.770"	Yes	BG,243
237-197	14.4KV	2/0 - 19	0.815"	Yes	BG,243
237-400	14.4KV	4/0 - 19	0.920"	Yes	247

Manufacturers Data:

Stock No.	Catalogue No.
237-200	2604600B32 MA RTE 166LRR-FAB-220 (Elastimold)
237-199	2604600B33 MA RTE 166LRR-FG-240 (Elastimold)
237-197	2604600B49 MA RTE 166LRR-FG-250 (Elastimold)
237-400	2604600B51 MA RTE 166LRR-GAB-270 (Elastimold)



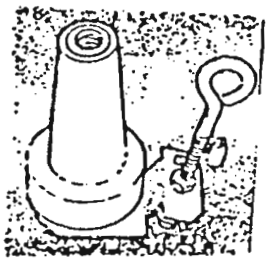
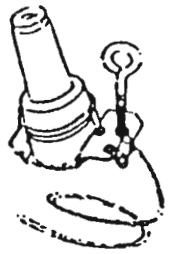
STANDOFF INSULATORS

Application: URD Systems

Description:

Stock No.	Voltage	Current	Type
237-228	15KV	200 amp	Parking
237-196	15KV	600 amp	Parking
237-232	15KV	200 amp	Grounding

Manufacturers Data:

Stock No.		Catalogue No.
237-228		2625063B01M (RTE) 160 SOP (Elastimold)
237-196		2604791B01M (RTE)
237-232		2637158B01M (RTE)

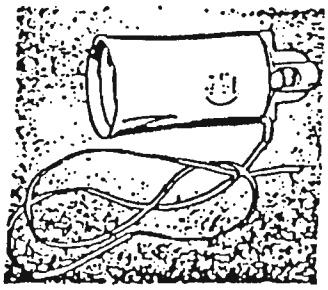
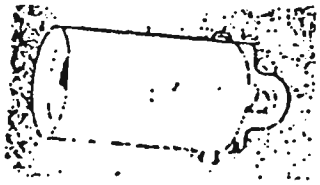
INSULATED PROTECTIVE CAPS

Application: Covering spare bushings

Description:

Stock No.	Voltage	Basic Impulse Level	Bushing Current Rating	Grounding Lead
237-194	15 KV	95 KV	200 amp	Yes
237-311	15 KV	95 KV	600 amp	Yes

Manufacturers Data:

Stock No.		Catalogue No.
237-194		2603711A12M (RTE) 160DRG (Elastimold)
237-311		2625041A01M (RTE)

MODULES

Application: Underground primary distribution

Description:

Stock No.	Amperage	Voltage	Positions	Mounting
237-217	200	15KV	3	Bracket included
237-220	600	15KV	3	Bracket included
237-218	200	15KV	4	Bracket included
237-214	600	15KV	4	Bracket included

Manufacturers Data:

Stock No.		Catalogue No.
237-217		2637172B02MG (RTE) 163J3R (Elastimold)
237-220		2604670B02M (RTE)
237-218		2637172B03MG (RTE) 163J4R (Elastimold)
237-214		2604670B03M (RTE)

FAULT INDICATORS

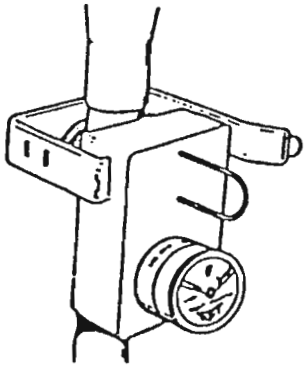
Application: Underground primary distribution

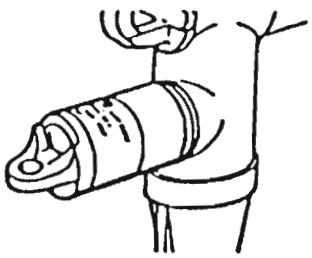
Description:

Stock No.	Type	Trip Setting	Reset	Cable	Elbow	Cable Diam. Over Semi-con Jacket (± .050 tol.)
237-502	cable	800 amp	3 amp	350	N/A	1.200 in.
237-502	cable	800 amp	3 amp	500	N/A	1.330 in.
237-503	cable	800 amp	3 amp	750	N/A	1.520 in.
237-504	test point	300 amp	5KV	1/0	200 amp	0.850 in.
237-504	test point	300 amp	5KV	4/0	200 amp	1.000 in.

Manufacturers Data:

Stock No.	Catalogue No.
237-502	8137268B04M (RTE) 1514RH-8A3-NTB (Fisher Pierce)
237-503	8137268B04ML (RTE) 1514RH-8A3-NTB (Fisher Pierce)
237-504	8125605A01M (RTE)





MOLDED RUBBER CABLE TERMINATIONS

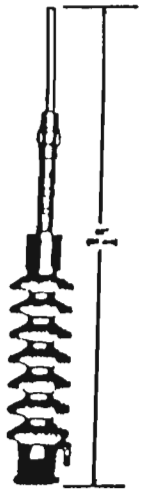
Application: Outdoor and indoor primary cable terminations for use on copper and aluminum shielded and concentric neutral type cables.

Description:

Stock No.	Voltage	Phase Conductor	Insulation O.D. (±.030)	Aerial Connector Type Needed
237-187	25 kv	#2-7 Str.	0.695"	Crimp
237-198	25 kv	1/0-19 Str.	0.770"	Crimp
237-201	25 kv	2/0-19 Str.	0.815"	Crimp
237-191	25 kv	4/0-19 Str.	0.920"	Crimp
237-212	15 kv	350-37 Str.	1.080"	2-Hole Spade
237-753	15 kv	500-37 Str.	1.210"	2-Hole Spade
237-740	15 kv	750-61 Str.	1.400"	2-Hole Spade

Manufacturers Date:

Stock No.	Catalogue No.
237-187	16THG-FAB-0220-4 (Elastimold)
237-198	16THG-FG-0240-4 (Elastimold)
237-201	16THG-GA-0250-4 (Elastimold)
237-191	16THG-GB-0270-4 (Elastimold)
237-212	35MTG-HAB-3504112 (Elastimold)
237-753	35MTG-HJ-5004222 (Elastimold)
237-740	35MTG-JB-7504222 (Elastimold)



COLD SHRINK CABLE TERMINATIONS

Application: Outdoor and indoor primary cable terminations for use on copper and aluminum concentric neutral type cables.

Description:

Stock No.	Voltage	Phase Conductor	Insulation O.D. (+.030)	Aerial Connector Type Needed
237-743	15 kv	#2-7 Str.	0.695"	Crimp
237-744	15 kv	1/0-19 Str.	0.770"	Crimp
237-746	15 kv	2/0-19 Str.	0.815"	Crimp
237-748	15 kv	4/0-19 Str.	0.920"	Crimp
237-749	15 kv	350-37 Str.	1.080"	2-Hole Spade
237-754	15 kv	500-37 Str.	1.210"	2-Hole Spade
237-755	15 kv	750-61 Str.	1.400"	2-Hole Spade

Manufacturers Data:

Stock No.	Catalogue No.
237-743	5601-2 (3M)
237-744	5601-1/0 (3M)
237-746	5601-2/0 (3M)
237-748	5601-4/0 (3M)
237-749	5602-40156 (3M)
237-754	5602-40166 (3M)
237-755	5602-40172 (3M)

EQUIPMENT BRACKETS

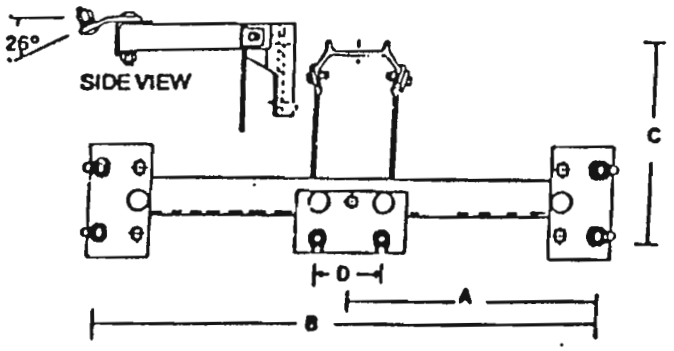
Application: URD Riser Poles (three phase)

Description:

Stock No.	Type	Length	Pole Clearance	Mounting
241-430	terminator/arrester	36"	12"	26°
241-443	cutout/arrester	48"	15"	0°
241-439	disconnect switches	48"	12"	110°

Manufacturers Data:

Stock No.	Catalogue No.
241-430	TB-EMB-1-6PA-35 (Alumaform)



DETAIL 6-11

UNDERGROUND SECONDARY CONNECTORS

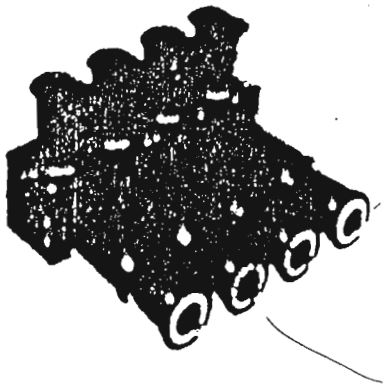
Application: URD secondary connections in handholes or direct buried (Copper or aluminum)

Description:

Stock No.	No. of Conductors	Conductor Range	Inhibitor Required
241-721	4	#6 - 350 MCM	Yes
241-722	6	#6 - 350 MCM	Yes

Manufacturers Data:

Stock No.	Catalogue No.
241-721	PED4-350-SS-P (Utilco) RAB-4-C (Homac)
241-722	PED6-350-SS-P (Utilco) RAB-6-C (Homac)



DETAIL 6-12

UNDERGROUND SECONDARY CONNECTORS

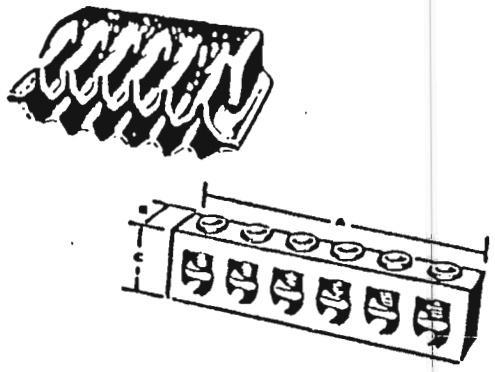
Application: URD secondary connections in pedestals
(Copper or aluminum)

Description:

Stock No.	No. of Conductors	With Plastisol Boot	Conductor Range
241-720	6	YES	#6-250 MCM

Manufacturers Data:

Stock No.	Catalogue No.
241-720	PED 6-250 with cover no. CAA (Utilco)



DETAIL 6-13

TRANSFORMER SECONDARY CONNECTORS

Application: URD secondary connectors for use on single phase padmounted transformers.

Description:

Stock No.	No. of Conductors	Conductor Range	For Transformer Stud	For Transformer Size	Inhibitor Required
241-719	6	#6-350 MCM	5/8 - 11	thru 75 kva	Yes
241-723	6	#6-500 MCM	1 - 14	100 kva	Yes

Manufacturers Data:

Stock No.	Catalogue No.
241-719	PTF6-350-CJU-P (Utilco) SC6-350-QC-I (Superior Connector Inc.)
241-723	PTF6-500-CJ-P (Utilco)

LOCK RINGS

Application: Pad Mount Transformers and/or pedestal locking

Description:

Stock No.	Ring I.D.	Overall Length	Alumoweld Gauge
237-249	Variable	Variable	4

Manufacturers Data:

Stock No.	Cataloge No.
237-249	PEL-1B (Utilico)

PEL-1B

DETAIL 6-15

UNDERGROUND SECONDARY HANDHOLES

Application: Underground secondary installation

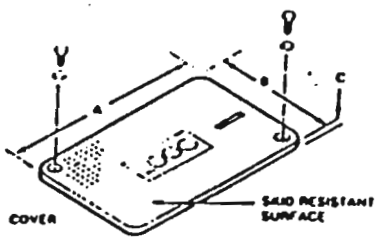
Description:

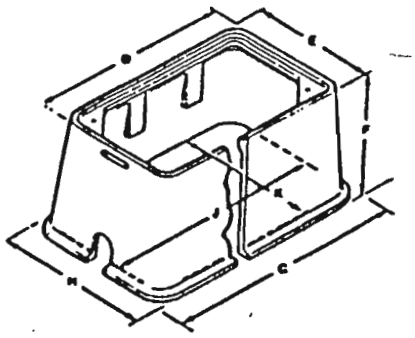
DIMENSIONS (IN.)

Stock No.	A	B	C	D	E	F	G	H	J	K
237-243	23½	13 3/4	3/4	24 7/8	15 3/8	16 3/4	29½	19 5/8	26½	15 7/8

Manufacturers Data:

Stock No.	Catalogue No.
237-243	PX1324BA Box and PX1324CA Cover with "ELECTRIC" logo (Quazite)





DETAIL 6-16

Town of Lyons
Electrical Distribution System Material and Design
INDEX

Section 6
Electrical Distribution System Design Standards

6.1 DESIGN CRITERIA

6.1.1 SUBMISSIONS: The electrical distribution system public improvement plans shall describe the proposed electrical distribution system in adequate detail so as to serve as construction drawings as well as satisfying the requirements of this section.

6.1.2 METHOD: The design of the electrical distribution system shall be based on standard design practices and design criteria contained in this section.

6.1.3 CRITERIA: The design of the electrical distribution system shall be based on the following:

1. In areas zoned for residential uses, the electrical distribution system and building services shall be installed underground with transformers, junction boxes, and pedestals surface mounted. Locations and general layout shall be as shown in Standards 6-1, 6-2 and 6-3.

2. In areas zoned for commercial and industrial uses, the electrical distribution system and building services may be installed underground or overhead. To be determined by Electrical Department.

3. The remainder of this section shall pertain to underground electrical distribution systems only. The design and construction of overhead electrical distribution systems and building services shall be coordinated with the Town administration prior to commencement.

4. Primary and secondary conductors will be placed in Schedule 40 PVC duct throughout the system. Conduit size to be determined by Town's Electric Engineer or Town staff. Minimum size duct shall be 2".

5. Town Electrical Engineer will determine wire sizes and system design at Developer's expense.

6. Joint Use Coordination:
    a. Whenever possible, construction will be coordinated with the telephone company and any authorized cable TV company so that they can install their facilities before final backfill.
    b. Upon receipt of a copy of the proposed development from the developer, the telephone company or CATV will make a layout for their facilities. The

Telephone Company or CATV will coordinate this layout with the town Electric Department for joint use trenches. The Telephone Company or CATV will coordinate this layout with the Town Electric Department for joint use trenches. The Telephone Company or CATV will then coordinate construction of their facilities directly with the developer.

6.2 SPECIFICATIONS

6.2.1 SCOPE: The work covered by these specifications concerns the furnishing of all labor, equipment, and materials and performing all operations for the construction of the electrical distribution system including primary and secondary lines, transformers, junction boxes, protective devices and other fittings and appurtenances in accordance with these specifications and the Standard Design Drawings in Paragraph 6.5.

6.2.2 GENERAL REQUIREMENTS: The electrical distribution system shall be constructed in accordance with engineered construction plans for the work prepared under the direction of a Town Engineer and approved by the Town Engineer.

6.2.3 MATERIALS: Will meet industry standards and be approved by the Electrical Department.

1. Conductor: All primary and secondary conductors will be new and on original factor reels marked with the manufacturer's name, address, type, date of manufacture and length of cable.

    a. Underground secondary cable shall be copper or aluminum, 600V, cross-linked polyethylene, triplexed UD cable. Cable size to be determined by Town's electrical Engineer.
    b. Under ground primary cable to be 25 Kv, XLPE, 220 mil Al. 1/3 neutral cable. Cable size to be determined by Town's Electrical Engineer.

2. Precast Concrete Underground Distribution Vaults:

    a. Vaults.

        (1) This Commercial specification covers the requirements for steel reinforced, precast concrete, underground distribution vaults. The structure described in this specification shall be used in conjunction with underground primary cable for three phase installations.

        (2) GENERAL. All vaults and components shall conform to this specification and associated drawings in all respects and be constructed using high quality materials in accordance with good industry practice. The Town Engineer will determine the dimensional requirements.

        (3) COMPONENTS.

(a) PULLING EYES: All pulling eyes or irons shall be capable of withstanding a 15,000-pound force.

b. Vault Frame and Cover:

(1) SCOPE. This specification covers the requirements for steel reinforced, precast concrete, underground distribution vault lids. The structure described in this specification shall be used in conjunction with electrical concrete vaults for Underground Distribution Systems.

(2) GENERAL. All vault lid components shall conform to this specification and associated drawings in all respects and be constructed using high quality materials in accordance with good industry practice.

(3) DESIGN. The present vault lid shall be designed to resist all dead loads and live loads equivalent to an H-20 or S-16 loading as stated in the latest revision of the AASHTO Standard Specifications for highway bridges. The combination of loads that produces the maximum shear and moment shall be used to design the structure.

The vault lid shall be adequately reinforced to resist the stresses resulting from the above loading conditions. The supplier shall be responsible for the structural design.

(4) CONSTRUCTION. The minimum compressive strength in all concrete components of the precast vault lid shall not be less than 4000 psi after it has cured to reach its 28 day strength. The maximum nominal aggregate size shall be ¾" and shall not exceed 1/5 of the minimum dimension of cross section of any one concrete casting. Four "swift lift" lifting anchors (recessed lugs) or four ¾" standard SAE threaded inserts shall be provided. These shall be located on the top face of the vault lid. The vault lid shall be constructed to the dimensions indicated on the attached drawings with all appurtenances firmly fixed in the forms to prevent dislodgment during construction and future use.

(5) COMPONENTS.

(a) FRAME AND COVER: Frameco Fabricators' galvanized steel frame and cover assembly or approved equal. The lid shall have "Torsion Spring Assisted: access doors rated for

H-20 (highway) traffic loading. The doors are either to be equipped with stops for latching in the open position or designed for removal by lift off. The access doors shall be secured by a recessed, captive pentahead bolt which threads into a nut with a blind hole. Frameco model #3' x 3' S.M.U.D. frame and cover shall be cast in all 5' x 5' O.D. vault lids for use with 4'x4'x4'x8" I.D. electric vaults (Spec. 13-20). Frameco catalog #4272 frame and cover shall be cast in all 5'x7' O.D. vault lids for use with 4'x 6'x 8" I.D. electric vaults (Spec. 13-30).

3. Transformer: All transformers shall be designed according to American National Standard Institute Type I design. Transformers will be pad-mounted, loop-feed, with load break primary bushings, 5/8 " brass stud, 2 primary taps 2 ½ % above and below normal and externally operable, primary load sensing fuse and isolation link. Manufacturer's metal nameplate with above data will be securely attached to the inside compartment of the transformer. Manufacturer will provide non-PCB label attached to transformer door. Manufacturer to provide along with other transformer information the type of insulating material used, i.e. petroleum products.

    a. All other major components of equipment shall have as a minimum the manufacturer's name, address, and catalog or style number on a nameplate securely attached to the item of equipment.

    b. All metallic materials shall be protected against corrosion. Aluminum shall not be used in contact with earth, and where connected to dissimilar metal, shall be protected by approved fittings and treatment. All ferrous metals such as anchors, bolts, braces, boxes, bodies, clamps, fittings, guards, nuts, pins, rods, shim, thimbles, washers and miscellaneous parts not of corrosion resistant steel, shall be hot-dip galvanized.

    c. Materials and equipment to be provided shall be essentially the standard cataloged products of a manufacturer regularly engaged in the manufacture of these products. Materials and equipment shall be installed in accordance with the approved recommendations of the manufacturer.

6.3 CONSTRUCTION

6.3.1 GENERAL REQUIREMENTS: Section 7, General Specifications, shall be followed except as modified in Paragraph 6.3.2.

6.3.2 SPECIFIC REQUIREMENTS: The following specific requirements shall apply in the construction of the electrical distribution system:

1. Trench Excavation Requirements:

a. The trench for direct-buried duct systems shall meet the following depth Requirements (see figures 6-5a and 6-5b).

(1) For residential applications all duct shall be a minimum of 36 inches below final sub-grade. The trench shall be no deeper than 42 inches below final sub-grade.

(2) For commercial application the trench shall be a minimum of 48 Inches below final sub-grade.

b. Trench backfill and Compaction Requirements:

(1) Single duct trench widths shall not exceed 24 inches.

(2) The Town shall not accept trenching outside of right-of-way or easement areas.

2. Trench Backfill and Compaction Requirements:

a. Backfill material shall be placed in uniform layers not exceeding 12 inches in uncompacted thickness and mechanically compacted using platform type tampersor other Town approved methods.

b. Backfill material shall be finely divided and free from debris and organic material. The first 12 inch lift shall contain no rocks larger than 3/4 inch in greatest dimension. Subsequent lifts shall contain no rocks larger than 3 inches in greatest dimension.

c. Trench backfill at all depths shall be compacted to not less than 95 percent of maximum density. Backfill for trenches traversing subgrades of roads, parking areas, underground piping, and other facilities subject to damage by settlement shall be compacted to not less than 95 percent of maximum density. ASTM Specification D698, otherwise known as Standard Proctor, shall define maximum density.

3. Duct Laying:

a. The duct shall be laid in a good workmanlike manner, with glued joints and smooth ends where duct requires cutting. The Town Inspector prior to concrete encasement when required will inspect the duct installation, ground rod locations and elbows up to surface apparatus.

b. When encasement is required, the duct run will be encased in four-sack mix concrete with ¾ inch aggregate. A minimum thickness of three inches will be maintained on top, bottom and sides of duct. Earth backfill will not be placed on concrete easement until concrete has set up enough to prevent displacement when earth fill is compacted. The earth backfill shall

then be placed in lifts not to exceed a loose depth of 10 inches. The lift shall be well tamped. This procedure shall be followed until a minimum of one (1) foot of compacted backfill covers the encasement. The maximum thickness of each lift after the one-foot of cover has been reached shall be 18 inches. The backfill at all depths shall be compacted to at least ninety-five percent (95%) of the maximum density obtainable by the Standard Proctor Density Test. See standard 5-1 for trench detail concrete encased ducts.

4. Installation of conductor:

   a. Pulling of conductors into duct runs shall be done with care to prevent damage. The reels shall be set up so there will be a minimum of bending into the cable entrance. Conduit shall have bell ends of guard protection at each end of the duct to protect the cable jacket. Where several wires or cables are to occupy one conduit, they will be pulled together. To facilitate the pulling of conductors, lubrication only as recommended by the cable manufacturer shall be used. Cable pulling tension and bending radius shall not exceed values as recommended by the cable manufacturer.

   b. Cables shall be attached to the pulling lines by means of woven cable or basket grips. A swivel connection shall be used with all cable pulling operations. The Town Inspector shall be present during all pulling operations. The cable ends shall be sealed with a moisture-tight seal.

   c. Conductors will be identified according to instructions from the Town Inspector.

5. Equipment Installation:

   a. Transformers: Transformers will be installed and wiring connections made as shown in standard and details 6-1, 6-2, 6-6A through 6-6D. The transformer box pad will be placed on soil that has been compacted to 95% of Standard Proctor to provide a level and stable foundation.

   b. Handholes or junction boxes: Handholes will be installed and wiring connections made as shown in Figures 6-7A and 6-7B on six to eight inches of ¾ inch crushed rock.

   c. Pedestals: Pedestals will be installed as shown in Figure 6-8 on six to eight inches of ¾ inch crushed rock.

6.4 TESTING

6.4.1 COMPACTION TEST: Compaction tests to verify specified compaction shall be performed as required in Section 7 of this manual.

6.5 CONSTRUCTION STANDARDS AND DETAILS

5-1 Typical Trench for concrete encased ducts

6-1 Front lot line U.R.D. construction design

6-2 Transformer box pad and conduit

6-3 Meter location

6-5A Typical trenches for direct buried ducts

6-5B Under ground street crossing

6-6 Loop system with radial tap showing lightning arrester locations

6-6A Ground assembly for pad-mounted single-phase transformers & enclosures

6-6B Typical primary connections on a grounded-front pad-mounted transformer

6-6C Bushing mounted lightning arrestor for a grounded-front pad-mounted transformer.

6-6D Single –phase pad-mounted transformer deferred unit, pedestal type.

6-6F Sectionalizing pedestal grounding.

6-6G Single-phase pad-mounted sectionalizing assembly

6-6H Three-phase pad-mounted sectionalizing assembly

6-6P URD service to typical apartment complex

6-7A Hand hole and secondary cable and duct

6-7B Front lot line hand hole, secondary cable and duct installation.

6-8 Below grade service pedestal

7-1 Three phase primary riser pole.

7-2 Three phase cable terminal pole with intermediate arresters and hook stick operated disconnect switches.

7-3 Single phase riser pole

7-4 Primary riser feeding single-phase transformer.

Specifications For Construction
For
Underground Distribution Systems

1. General

These specifications provide for the construction of underground distribution power facilities by the cable installed in conduit and trenching.

All construction work shall be done in a thorough and workmanlike manner in accordance with the staking sheets, plans and specifications, and the construction drawings.

The most current Edition of the National Electrical Safety Code (ANSI C2-1981) shall be followed, except where local regulations are more stringent, in which case local regulations shall govern.

2. Handling of Cable

Cable shall be handled carefully at all times to avoid damage, and shall not be dragged across the ground, fences or sharp projections. Care shall be exercised to avoid excessive bending of the cable. The ends of the cable shall be sealed at all times against moisture with suitable end caps. Where it is necessary to cut the cable, the ends shall be terminated or sealed immediately after the cutting operation.

3. Trenching

All trenching depths specified are minimum as measured from the final grade to the top surface of the conduit. The routing shall be as shown on the staking sheets and plans and specifications unless conditions encountered are such that changes are necessary to accomplish the work. In such event, the Engineer shall be notified promptly. If rock or other difficult digging is involved, the contractor shall determine the nature and extent of the difficulty, and the Engineer will determine whether rerouting, rock trenching, or other changes are necessary. Loose soil or crumbly rock will not be considered as “difficult digging.” The trench widths specified are minimum and should be increased as necessary to obtain the required depths in loose soils.

4. Conduit

All exposed ends of conduit shall be plugged during construction to prevent the entrance of foreign matter and moisture into the conduit. Burrs or sharp projections, which might injure the cable, shall be removed. Riser shield or conduit shall extend at least 1.0 foot below grade at all riser poles. The minimum size of conduit, or riser guard with equivalent usable area is to be determined by the Town Engineer.

5. Installation in Conduit or Duct

Where cable must be pulled through conduit or duct, the operation shall be performed in such a way that the cable will not be damaged from strain or dragging. The cable shall be lubricated with a suitable cable lubricant prior to pulling into conduit or duct.

In placing primary cables, the stress applied while pulling into ducts or during other pulling operations shall not exceed the least of the following:

a. Where a pulling eye is attached to the conductor, the maximum pulling strain in pounds shall not exceed .006 times the circular mil area for aluminum or .008 times the circular mil area for copper.
b. Where a basket grip is placed over the cable, the pulling strain shall not exceed the lesser of (1) that calculated in an above or (2) 1000 pounds. The cable under the cable grip and 3.0 foot preceding it shall be severed and discarded after the pulling operation.
c. In no case shall the maximum pulling tension exceed that recommended by the specific cable manufacturer.
d. At bends the maximum sidewall pressure recommended by the cable manufacturer shall not be exceeded.

6. Tagging of Cables at Termination Points

As the cables are laid they shall be identified and tagged. The identification shall be a permanent type, such as that done with an embossing type tape writer on plastic and colored cable tape. The tag shall be securely attached to the cable.

7. Secondary and Service Connections

A suitable inhibiting compound shall be used with all secondary and service connections.

All secondary cable connections located below grade or in secondary pedestals shall be made with preinsulated secondary connector blocks. Diving bells with open terminals, insulating boots or moisture barriers that depend solely on tape are not acceptable.

All transformer secondary phase terminal connections shall be completely insulated. If the secondary phase terminals are threaded studs, the connection shall be made with a preinsulated secondary transformer connection block. If the transformer secondary phase terminals are insulated cable leads, connection shall be made with a preinsulated secondary connector block or with a secondary prefabricated splice when the transformer leads continue directly to the service.

If a transformer is so large that it must have secondary spades, the spades shall be taped or otherwise insulated. Boots used for insulation shall be taped so that they cannot be readily slipped off.

Secondary connections to terminals of pole-mounted transformers shall be made so that moisture cannot get inside the cable insulation. This may be accomplished by covering the terminals and bare conductor ends with an appropriate moisture sealant (item “es” in the List of Materials).

The secondary connections and insulation shall have accommodations for all future and existing services as shown on the plans and specifications.

8. Inspection and Inventory of Buried Units

Before any backfilling operations are begun, the contractor and Town shall jointly inspect all trenches, cable placement, risers, pedestal stakes, and other construction not accessible after backfilling, and an inventory of units shall be taken. If corrections are required, a second inspection shall be made after completion of the changes.

9. Backfilling

The first 12 inches of trench backfill shall be free from rock, gravel larger than ¾”or other material, which might damage the conduit. In lieu of cleaning the trench, the contractor may, at his option, place a 4-inch bed of clean sand or soil under the conduit and twelve inches of clean soil above the conduit. Cleaned soil backfill when used shall contain no solid material larger than ¾”. This soil layer shall be carefully compacted so that the conduit will not be damaged.

Backfilling shall be completed in such a manner that voids will be minimized. Excess soil shall be piled on top and shall be well tamped. All rock and debris shall be removed from the site, and any damage to the premises repaired immediately.

Pieces of scrap cable shall not be buried in the trench as a means of disposal.

10. Equipment Pads

The site for the pad shall be on undisturbed earth adjacent to but not over the trench. The site shall be cleared of all debris and excavated to the specified depth. Gravel, sand or other acceptable self-draining material shall be added to the site and thoroughly compacted. The pad shall be installed at the specified elevation. Poly pads, precast concrete, or cast-in-place concrete may be used.

11. Transformers

Transformers shall be handled carefully to avoid damage to the finish and shall be positioned in accordance with the staking sheets and the plans and specifications. Only qualified and experienced personnel shall be allowed to make connections and cable terminations.

12. Equipment Enclosures

Excavations for transformer hole liners and other below-grade enclosures shall be made so as to disturb the surrounding earth as little as practical. Enclosures shall be installed with sidewalls plumb or the top of enclosure level.. When enclosures are of fiber, plastic, or other semi flexible material, backfilling should be done with covers in place and with careful tamping so as to avoid distortion of the enclosure. When installation is complete, the cover of the enclosure shall not be lower than and not more than two inches higher than the grade specified by the Town. Soil in the immediate vicinity shall be tamped and sloped away from the enclosure. At the Town's option the excess soil shall be removed from the site or spread evenly over the surface of the ground to the satisfaction of the Town.

Warning:

A hazardous voltage may exist on the cable after de-energizing. Therefore, before the handling the cable, the conductor shall be grounded to permit any charge to drain to earth.

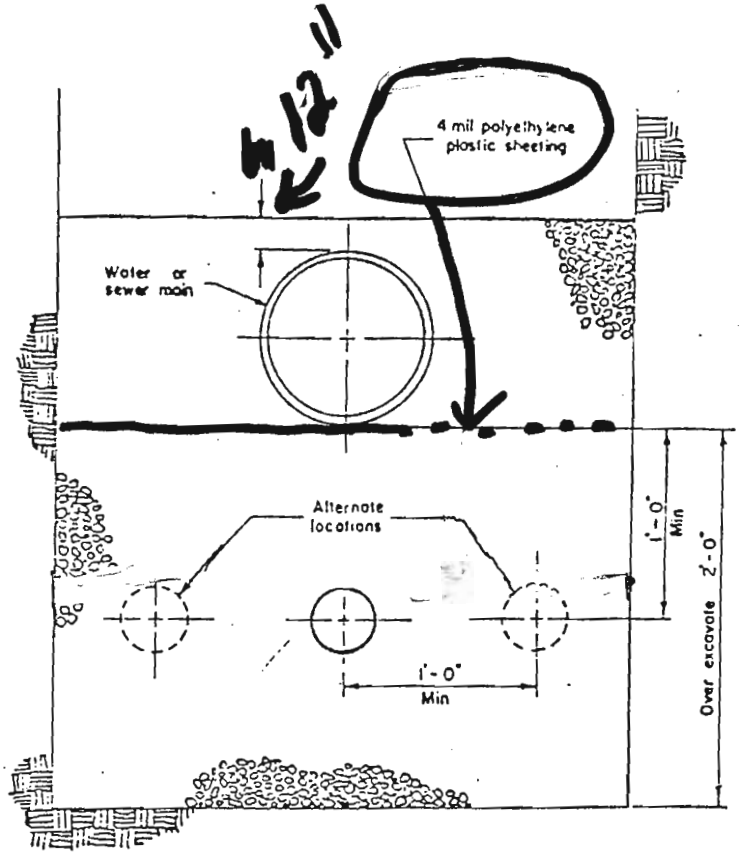


FIGURE 7-1

UNDER DRAIN DETAILS

Section 7
GENERAL SPECIFICATIONS

7.1 SPECIFICATIONS

7.1.1 SCOPE: The work covered by this specification concerns the furnishing of all labor, equipment and materials, and the performing of all operations generally encountered in construction of utilities streets in accordance with this specification and the Standard Design Drawings of Paragraph 7.4.

7.1.2 DEFENITIONS:

Accepted Engineering Requirements (or Practices). Those requirements or practices which are compatible with standards required by a registered professional engineer or other duly licensed or recognized authority.

Angle of Repose. The greatest angle above the horizontal plane at which a material will lie without sliding.

Bank. A mass of soil rising above the digging level.

Belled Excavation. A part of a shaft or footing excavation, usually near the bottom and belled-shaped; i.e., an enlargement of the cross section of the shaft.

Braces (trench). The horizontal members of the shoring system whose end bear against the uprights or stringers.

Excavation. Any man-made cavity or depression in the earth's surface, including its sides, walls or faces, formed by earth removal and producing unsupported earth conditions by reasons of the excavation. If installed forms or similar structures increase the depth-to-width relationship, an excavation may become a trench.

Hard Compact Soil. All earth materials not classified as unstable.

Kickouts. Accidental release or failure of a shore or brace.

Sheet Pile. A pile, or sheeting, that may form one of a continuous interlocking line, or a row of timber, concrete, or steel piles driven in close contact to provide a tight wall to resist the lateral pressure of water, adjacent earth or other materials.

Sides, Walls, or Faces. The vertical or inclined earth surfaces formed as a result of excavation Work.

Slope. The angle with the horizontal at which a particular earth material will stand indefinitely without movement.

Stringers (wales). The horizontal members of a shoring system whose sides bear against the uprights or earth.

Trench. A narrow excavation made below the surface of the ground. In general, the depth is greater than the width, but the width of a trench is not greater than fifteen (15) feet.

Trench Jack. Screw or hydraulic type jacks used as cross bracing in a trench shoring system.

Trench Shield. A shoring system composed of steel plates and bracing, welded or bolted together, which supports the walls of a trench from the ground level to the trench bottom, and which can be moved along as work progresses.

Unstable Soil. Earth material that, because of its nature or the influence of related conditions, cannot be depended upon to remain in place without extra support, such as would be furnished by a system of shoring.

Uprights. The vertical members of a shoring system.

7.2 GENERAL EXCAVATION AND TRENCHING

7.2.1 REQUIREMENTS: The Town Engineer shall be notified twenty four (24) hours before the planned construction is to commence and also before starting up whenever construction is delayed for any reason. Paragraph 7.2.2 shall apply to the construction of all public improvements as applicable.

7.2.2 GENERAL EXCAVATION AND TRENCHING: All excavation work shall conform to Part 1518-Safety and Health Regulations for Construction; of the Federal Register, Volume 36, Number 75, Department of Labor, Bureau of Standards, April 17, 1971, or the latest revision. All subparts referred to in this section are documented in Part 1518 of the Federal Register, Subpart P-Excavation, Trenching and Shoring. Work shall be carried on in a manner that will cause the least possible interference with traffic.

1. Safety.

    a. Walkways, runways, and sidewalks shall be kept clear of excavated material or other obstructions and no sidewalks shall be undermined unless shored to carry a minimum live load of one-hundred and twenty-five (125) pounds per square foot.
    b. If planks are used for raised walkways, runways, or sidewalks, they shall be laid parallel to the length of the walk and fastened together against displacement.
    c. Planks shall be uniform in thickness and all exposed ends shall be provided with beveled cleats to prevent tripping.

d. All employees shall be protected with personal protective equipment for the protection of head, eyes, respiratory organs, hands, feet and other parts of the body as set forth in Subpart "E" of Part 1518.
e. Employees exposed to vehicular traffic shall be provided with and shall be instructed to wear warning vests marked with or made of reflectorized or high visibility material.
f. Employees subject to hazardous dust, gases, fumes, mists or atmospheres deficient in oxygen, shall be protected with approved respiratory protection as set forth in Subpart "D" of Part 1518.
g. No person shall be permitted under loads handled by power shovels, derricks or hoists. Employees shall be required to stand away from vehicles being loaded.
h. Daily inspections of excavations shall be made by a competent person. If evidence of possible cave-ins or slides is apparent, all work in the excavation shall cease until the necessary precautions have been taken to safeguard the employees.
i. Adequate barricades, signs and warning devices shall be placed and maintained during the progress of the work.

2. Excavation.

a. Prior to opening an excavation, every effort shall be made to determine whether underground installations, i.e., sewer, water, fuel, electric lines, etc., will be encountered, and if so, where such underground installations are located. When the excavation approaches the estimated location of such an installation, the exact location shall be determined by careful probing by hand digging, and when it is uncovered, proper supports shall be provided for the existing installation. Utility companies shall be contacted and advised of proposed work prior to the start of actual excavation.
b. Trees, boulders and other surface encumbrances located so as to create a hazard to employees involved in excavation work or in the vicinity thereof, at any time during operations, shall be removed or made safe before excavating is begun.
c. Excavations shall be inspected by a competent person after every rainstorm or other hazard-increasing occurrence, and the protection against slides and cave-ins shall be increased if necessary.
d. The determination of the angle of repose and design of the supporting system shall be based on careful evaluation of pertinent factors such as: depth of cut; possible vartiation in water content of the material while the excavation is open; anticipated changes in materials from exposure to air, sun, water, of freezing; loading imposed by structures, equipment, overlying material, or stored material; and vibration from equipment, blasting, traffic or other sources.
e. Supporting systems, i.e., piling, cribbing, shoring, etc., shall be designed by a qualified person and meet accepted engineering requirements. When tie rods are used to restrain the top of sheeting or other retaining systems, the rods shall be securely anchored well back of the angle of repose. When tight sheeting or sheet piling is used, full loading due to ground water table shall be assumed, unless prevented by weep holes or drains or other means. Additional stringers,

ties and bracing shall be provided to allow for any necessary temporary removal of individual supports.

f. All slopes shall be excavated to at least the angle of repose except for areas where solid rock allows for drilling or presplitting.
g. The angle of repose shall be flattened when an excavation has water conditions, silty materials, loose boulders, and where erosion, deep frost action and slide planes appear.
h. Excavated or other material shall not be stored nearer than four (4) feet from the edge of any excavation and shall be so stored and retained as to prevent its falling or sliding back into the excavation. Material shall be stored so as not to obstruct sidewalks or driveways and provide least possible interference with traffic.
i. Slides, slopes and faces of all excavations shall meet accepted engineering requirement by scaling, benching, barricading, rock bolting, wire meshing, or other equally effective means. Special attention shall be given to slopes which may be adversely affected by weather or moisture content.
j. Support systems shall be planned and designed by a qualified person when excavation is in excess of twenty (20) feet in depth, adjacent to structure or improvements, or subject to vibration or ground water.
k. Materials used for sheeting, sheet piling, cribbing, bracing, shoring, and underpinning shall be in good serviceable condition, and timbers shall be sound, free from large or loose knots, and of proper dimension.
l. Special precautions shall be taken in sloping or shoring the sides of excavations adjacent to a previously back-filled excavation or a fill, particularly when the separation is less than the depth of the excavation. Particular attention also shall be paid to joints and seams of material comprising a face and the slope of such seams and joints.
m. Except in hard rock, excavations below the level of the base of footing of any foundation or retaining wall shall not be permitted, unless the wall is underpinned and all other precautions taken to ensure the stability of the adjacent walls for the protection of employees involved in excavation work or in the vicinity thereof.
n. If the stability of adjoining buildings or walls is endangered by excavations, shoring, bracing or underpinning shall be provided as necessary to ensure their safety. Such shoring, bracing or underpinning shall be inspected daily or more often, as conditions warrant, by a competent person and the protection effectively maintained.
o. Diversion ditches, dikes, grading, or other suitable means shall be used to prevent surface water from entering an excavation and to provide adequate drainage of the area adjacent to the excavation. Water shall not be allowed to accumulate in an excavation.
p. If it is necessary to place or operate power shovels, derricks, trucks, materials or other heavy objects on a level above and near an excavation, the side of the excavation shall be sheet-piled, shored and braced as necessary to resist the extra pressure due to such super-imposed loads.
q. Blasting and the use of explosives shall be performed in accordance with the Subpart “U” of Part 1518 and Paragraph 7.2.4 of this manual.

r. When mobile equipment is utilized or allowed adjacent to excavations, substantial stop logs or barricades shall be installed. If possible, the grade should be away from the excavation.
s. Adequate barrier physical protection shall be provided at all excavations. All wells, pits, shafts, trenches, etc., shall be barricaded or covered. Upon completion of exploration and similar operations, temporary wells, pits, shafts, etc., shall be backfilled.
t. If possible, dust conditions shall be kept to a minimum by the use of water, salt, calcium chloride, or other means.
u. In locations where oxygen deficiency or gaseous conditions are possible, air in the excavation shall be tested. Controls, as set forth in Subparts "D" and "E" of Part 1518, shall be established to assure acceptable atmospheric conditions. When flammable gases are present, adequate ventilation shall be provided or sources of ignition shall be eliminated. Attended emergency rescue equipment, such as breaking apparatus, a safety harness and line, basket stretcher, etc., shall be readily available where adverse atmospheric conditions may exist or develop in an excavation.
v. Where employees or equipment are required or permitted to cross over excavations, walkways or bridges with standard guardrails shall be provided.
w. Where ramps are used for employees or equipment, they shall be designed and constructed by qualified persons in accordance with accepted engineering requirements.
x. All ladders used on excavation operations shall be in accordance with the requirements of Subpart "L" of Part 1518.

3. Trenching:
   a. Banks more than four (4) feet high shall be shored or sloped to the angle of repose where a danger of slides or cave-ins exists as a result of excavation.
   b. Sides of trenches in unstable or soft material, four (4) feet or more in depth, shall be shored, sheeted, braced, sloped or otherwise supported by means of sufficient strength to protect the employees working within them.
   c. Sides of trenches in hard or compact soil, including embankments, shall be shored or otherwise supported when the trench is more than four (4) feet in depth and eight (8) feet or more in length. In lieu of shoring, the sides of the trench above the four (4) foot level may be sloping to preclude collapse, but shall not be steeper than a one (1) foot rise to each one-half (1/2) foot horizontal. When the outside diameter of a pipe is greater than six (6) feet, a bench of four (4) foot minimum shall be provided at the toe of the sloped portion.
   d. Materials used for sheeting and sheet piling bracing, shoring and underpinning, shall be in good serviceable condition and timbers used shall be sound and free from large or loose knots, and shall be designed and installed so as to be effective to the bottom of the excavation.
   e. Additional precautions by way of shoring and bracing shall be taken to prevent slides or cave-ins when excavations or trenches are made in locations adjacent to backfilled. Excavations or where excavations are subjected to vibrations from railroad or highway traffic, the operation of machinery or any other source.

f. Employees entering bell-bottom pier holes shall be protected by the installation of a remove able-type casing of sufficient strength to resist shifting of the surrounding earth. Such temporary protection shall be provided for the full depth of that part of each pier hole which is above the bell. A lifeline, suitable for instant rescue and securely fastened to a shoulder harness, shall be worn by each employee entering the shafts. This lifeline shall be individually manned and separate from any line used to remove materials excavated from the bell footing.
g. Where employees are required to be in trenches three (3) feet deep or more, ladders, extending from the floor of the trench excavation to at least three (3) feet above the top of the excavation, shall be provided and so located as to provide means of exit without more than twenty-five (25) feet of lateral travel.
h. Bracing and shoring of trenches shall be carried along with the excavation.
i. Cross branches or trench jacks shall be placed in true horizontal position, be spaced vertically and be secured to prevent sliding, falling or kick-outs.
j. Portable trench boxes or sliding trench shields may be used for the protection of employees only. Trench boxes or shields shall be designed, constructed and maintained to meet acceptable engineering standards.
k. Backfilling and removal of trench supports shall progress together from the bottom of the trench. Jacks or braces shall be released slowly and in unstable soil, ropes shall be used to pull out the jacks or braces from above after employees have cleared the trench.
l. The Developer shall, for a period of one (1) year after completion and acceptance of trench work, maintain and repair any trench settlement which may occur and shall make suitable repairs to any pavement, sidewalks or other structures which may be damaged as a result of backfill settlement. When the developer is notified by the Town that any backfill is hazardous he shall correct such hazardous condition at once or the Town may choose to make the repairs and bill the Developer for the work performed.

7.2.3 PROTECTION OF UTILITY LINES, STRUCTURES, AND PUBLIC AND PRIVATE INSTALLATIONS: The Contractor shall take proper precautions for the protection of utility lines, manholes, valve boxes, survey monuments and other structures, the presence of which are known or can be determined by examination of appropriate maps. He shall notify the Owner of the utility when working near a utility line or appurtenance or when the presence of these utilities is suspected in utilities or other structures. Should the Contractor in any way cause damage to utility lines, he shall be solely responsible for notifying the utility company involved and shall be liable for all costs involved in repairing the damaged line. All existing manholes and valve boxes shall be adjusted to final grade by the Contractor. Where spacer rings are installed, they shall have a wide slotted flange for support and be equal to Clay-Bailey #3100 or as approved by the Town representative. If any existing manhole rings and covers or valve boxes are found to be defective, they shall be replaced as directed by the Town representative.

The Contractor shall take proper precautions for the protection of and replacement or restoration of driveway culverts, street intersection culverts or gutter pans, storm drains or inlets, fences, irrigation ditches, crossings and diversion boxes, mail boxes, shrubbery, flowers, ornamental trees, driveway approaches and all other public or private installations

that may be encountered during construction. He shall have the responsibility of providing each property with access during the time of construction. Existing driveways shall be cut, filled and graded as required or as directed by the Town representative to provide permanent access. Existing driveways shall be resurfaced with the presently existing type of surfacing, whenever existing surfaces are destroyed.

7.2.4 EXPLOSIVES: Explosives may be used only after obtaining an explosive permit authorized by the Town Administrator, in conformance with Section 9-10 of the Lyons Municipal Code. Explosives shall be handled, used, and stored in accordance with all applicable regulations. The Town Administrator's approval of the use of explosives shall not relieve the contractor from his liability for claims caused by his blasting operations. All explosives shall be stored in a secure manner in compliance with all laws and ordinances, and all such storage places shall be clear marked. Where no local laws or ordinances apply, storage shall be provided satisfactory to the Town Engineer and in general no closer than 1,000 feet from the road or from any building or camping area or place of human occupancy.

The contractor shall be responsible for notifying each utility company having structures or other lines in proximity to the site of the work of his intention to use explosives. Such notice shall be given in writing a week in advance to enable the various companies to take such steps as they may deem necessary to protect their facilities from damage.

The contractor shall indemnify and save harmless the Town of Lyons, its officers and employees, from all suits, actions, claims, losses, or expenses of any character brought because of any injuries or damages alleged to have been received or sustained by any person, persons, or property on account of the operations of the contractor.

7.2.5 GENERAL PIPE INSTALLATION: Piping for storm drainage, irrigation lines, sanitary sewers, water systems, service lines and laterals, to be installed in easements or public right-of-way, under the jurisdiction of the Town, shall be excavated, bedded, backfilled and the trench resurfaced in accordance with approved engineered plans, and these specifications.

1. Separation of Water Mains and Sewers:
    a. Water mains shall be laid at least ten (10) feet horizontally from any sanitary sewer, storm sewer or sewer manhole. The distance shall be measured edge-to-edge.
    b. When local conditions prevent horizontal separation at ten feet, a water main may be laid closer to a storm or sanitary sewer provided that:
        1) The invert of the water main is at least eighteen (18) inches above the crown of the sewer main.
        2) If the invert of the water main is less than eighteen (18) inches above crown of the sewer main, the sewer shall be encased in concrete until there is a horizontal separation of ten feet on either side of the water main.

    c. When water mains cross storm or sanitary sewers:
        1) The invert of the water main shall be at least eighteen (18) inches above the crown of the sewer main.

2) If the invert of the water main is less than eighteen (18) inches above crown of the sewer main, the sewer shall be encased in concrete for a distance of ten (10) feet perpendicular to each side of water main. One full length of water main shall be centered on the sewer so that both joints will be as far from the sewer as possible.

d. The minimum clearance between storm sewer and sanitary sewer, either above or below, shall be 12 inches. However, when a sanitary sewer main lies above a storm sewer, or within 18 inches below, the sanitary sewer shall be constructed of materials and with joints equivalent to water main standards or shall be encased in concrete for a minimum of 10 feet on each side of where the storm sewer crosses.
e. All water and sewer main crossings shall be shown in plan and profile on the utility plans submitted to the Town for approval.
f. Encasement shall be interpreted to mean placing concrete, on a prepared subgrade and between formed sides so as to encase the line a minimum of six (6) inches on all sides. Pipe shall be wrapped with 8 mil plastic prior to concrete placements.

Backfill along the sides and over the concrete encasement shall be a well graded material, hand tamped to a 95% dry density, one (1) foot each side of the encasement. The trench shall then be backfilled to surface subgrade in accordance with Section 7.

2. Materials: Materials, other than pipe and fittings, which are to be placed within the trench limits and below finished grade, shall conform to the minimum standards hereinafter referred to.
   Specifications and detailed recommendations for acceptable practices set forth by the American Society for Testing Materials (ASTM), the American Association of State Highway Officials (AASHO) and the Colorado Department of Highways (CDH) are made a part of these specifications.
   a. Pipe Foundation Stabilizer ¾ " to 1-1/2" dense, durable rock with less than 15% passing the #4 sieve.
   b. Pipe Bedding: Free draining material meeting the following general gradation:

%Passing Designated Sieve

Sieve			Crusher Products			Structure
Size	Sand	Squee	Fines	Base	Fill Sand	Backfill
2"						100
¾"				100		
½"				90-100		
3/8"	100	100	100	75-90	100	
#4	95-100	40-90	95-100	55-75	65-90	30-100
#16	45-80					
#50	10-30					60 max.
#100	2-10					
#200		0-5	0-12	0-12	0-5	5-20
LL						35 max.
PI						6 max.

Note: (1) Shall only be used on fliexible conduits 36" in diameter and larger.

c. Backfill:

Soils and soil aggregate mixtures classified in accordance with AASHMO M-145, Table 2, which also meets the categories hereinafter specified.

A Special Backfill Material

	Gravel, Stone Fragments, Sands and Silty Soils			
Group Classification	A-1-a	A-1-b	A-3	A-2-4
Sueve Analysis- % Passing				
#10	50 max.			
#40	30 max.	50 max.	51 min.	
#200	15 max.	25 max.	10 max.	35 max.
Characteristics of Fractions (-#40 Sieve) L.L.				40 max.
P.I.	6 max.	6 max.	N.P.	10 max.

B Acceptable Backfill Material

	Silty or Light Clayed Gravel Sand and Soils			
Group Classification	A-2-5	A-4	A-5	
Sieve Analysis % Passing				
#200	35 max.	36 min.	36 min.	
Characteristics of Fraction(- #40 Sieve) LL	41 min.	40 max.	41 min.	
PI	10 max.	10 max.	10 max.	

C Generally Unacceptable Backfill Material

	Heavy Clayey Gravels and Soils			
Group Classification	A-2-6	A-2-7	A-6	A-7
Sieve Analysis - % Passing				
#200	35 max.	35 max.	36 min.	36 min.
Characteristics of Fractions (- #40 Sieve) L.L.	40 max.	41 min.	40 max.	41 min.
P.I.	11 min.	11 min.	11 min.	11 min.

Note: Material in Category "C" above shall be disposed of and replaced with acceptable material.

3. Construction:

   a. Excavation: The excavation shall be made to lines and grades shown on the plans and as established by the Engineer. All excavation shall be unclassified and the contractor shall be responsible for and take special precautions to prevent damage to all adjacent structures. Ground shall be excavated in open trenches, except where tunneling is called for in the plans or considered necessary or proper by the Town Inspector. Prior to excavating in hard surfaced areas, the outer limits of the trench shall be stringlined and the surfacing cut in a vertical plane by sawing or roller blade. Nominal trench width Limits at the surface, which shall be the width used in determining the quantity of resurfacing or patching for payment shall be three feet plus the outside diameter of the pipe, unless otherwise approved in by the Town Inspector. During construction, should the vertical asphalt edges ravel, they shall be trued to a vertical plane to a point six inches outside the limits of excavation prior to placing the resurfacing material.
   Surfacing materials such as concrete and asphalt shall be removed to neat lines and disposed of independently of the underlying soil; base course and gravels are to be salvaged to stock-pile, protected from contamination and reused for special backfill.
   Soils removed from the trench which meet the requirements for backfill materials, shall be stockpiled in a manner which will not endanger the performance of work, obstruct sidewalks or driveways and provide the least possible interference with traffic. Soils encountered which are unacceptable for use as backfill shall be disposed of by the contractor at his expense.

   b. Trenching: Trenches shall be excavated to the depth required for the bedding and foundations of the pipe and appurtenances. Where underdrains are to be installed, the trench shall be dug to the cross section shown on the Town of Lyons Standard Design Drawings, Figure 7-1.
   The width of the trench shall be ample to permit the pipe to be laid and joined properly and the backfill to be placed and tamped. In order to prevent the application of superimposed loadings on pipe in excess of the designed and specified pipe strengths, the maximum width of the bottom portion of the pipe trench as dug (for a vertical distance above the pipe subgrade equal to the outside diameter of the pipe plus six (6) inches) shall not exceed the outside diameter of the pipe plus 24 inches. Where, because of caving, blasting or other causes, the trench width exceeds that allowed herein, the Contractor will be required to lay the pipe in a bedding of suitable selected granular material, or encase the pipe in concrete, to protect the pipe from excessive loading.
   Excavation will not be permitted to advance more than 150 feet ahead of pipe laying and 200 feet ahead of backfill operations. The contractor shall provide and maintain adequate equipment to properly remove and dispose of all surface or ground water entering the trench. The use of any pipe line under construction to dispose of trench water will not be permitted. The trench shall be dry at all times during pipe installation and so maintained until the jointing operation is complete.

Where soft unstable soils, dense shale, or rock is encountered at the normal trench bottom, the contractor shall undercut and dispose of such materials, to the limits established by the Town representative, and backfill the void thus created with pipe foundation stabilizer material and bedding material.
In dense shale or rock the undercutting shall be not less than 6 inches and in unstable soils to not less than 12 inches below the bottom of the pipe barrel and the void replaced to within three inches of the pipe with the stabilizer material.

c. Bedding: All pipe, regardless of type or diameter, shall be installed on sufficient bedding material so as to provide a minimum of 3 inches separation between the subsoil and the pipe barrel, after consolidation. Where pipe collars, bells or flanges protrude in excess of 3 inches from the pipe barrel, the contractor shall hand excavate in these areas sufficiently to allow the pipe barrel to rest uniformly on the bedding material. Pipe being supported by the collars, bells or flanges on natural soils will not be allowed. Unauthorized and excessive trench depths shall be filled to bedding subgrade with foundation stabilizer material at the contractor's expense. Reuse of trench excavated soils will not be permitted in the trench until the pipe and bedding materials have been properly installed.
Pipe 16 inches and smaller in diameter, regardless of type, and all non-reinforced concrete, clay, asbestos cement, ductile iron, cast iron, CSP, PVC and steel pipe, regardless of diameter shall also be enveloped with consolidated bedding material between the trench banks and to a cover above the pipe of not less than 12 inches. French or perforated under-drains shall be fully embedded in pipe foundation stabilizer material to 6 inches each side of the pipe unless otherwise detailed on the drawings.
Reinforced concrete and pre-stressed concrete cylinder pipe, 18 inches and larger in diameter, need only be encased to springline with consolidated bedding material between the trench banks.

d. Bedding Installation: Pipe bedding material shall be placed in the trench to a loose depth of 4 inches and then fine graded along the pipe center line to a thickness of 3 inches. Special precautions shall be taken to remove sufficient bedding material at the point where the pipe bell, collar or flange will fall to insure a uniform bearing of the pipe barrel throughout its entire length.
After the pipe is properly set and jointed to line and grade and inspected by the Town Inspector, a second loose lift of bedding material, not to exceed 8 inches, shall be placed along each side of the pipe and then consolidated by tamping or vibration until uniform support under the pipe haunch is obtained. All additional bedding shall be carefully placed to the limits specified and consolidated by a combination of tamping and vibrating. At all times special precautions shall be taken to prevent displacement of or damage to the pipe. No pipe shall be covered before being inspected by the Town Inspector. Bedding material shall be compacted to 95 percent of Standard Proctor when tested in accordance with AASHO T99.

e. Underdrains: Underdrains shall be installed where shown on the approved plans. Where excessive ground water is encountered, the Town Engineer may also

require construction of gravel or piped underdrains as necessary to reduce infiltration. Underdrains shall be daylighted to the nearest suitable point designated on the approved plans or by the Town Engineer. The trench shall be excavated to the required depth and width and backfilled with washed pipe stabilizer material as shown in Figure 7-1. Underdrain pipe shall be installed to a true line and grade and shall be provided with cleanouts within each manhole installed on the line. Underdrain pipe shall be continued under manholes by use of suitable bends and other fittings.

f. Pipe Handling: Pipe shall be hauled, handled and lowered into the trench in such a manner as to insure against breakage, damage of interior and exterior coatings and the bell and spigot ends. All pipe delivered to job site is subject to Town inspection and may be rejected based on the Inspector's judgement.
All pipe and fittings shall be carefully examined for cracks and other defects while suspended above the trench immediately before installation in final position. The groove in the bells of cast iron pipe shall be full and continuous or the pipe shall be removed from the job site within 24 hours. All foreign matter or dirt shall be removed from the interior and ends of pipe and accessories before they are lowered into position in the trench.
Every precaution shall be taken to prevent foreign materials, including trench water, from entering the pipe.

g. Alignment and Grade: Pipe shall be laid accurately to the line and grade indicated in the approved drawings by the use of grade bars (batter boards) or suitable surveying instruments operated continuously during construction. Determination of correct line and grade shall be made under the supervision of a registered engineer or land surveyor.

h. Backfill and Compaction: After placing pipe and pipe bedding the open trench shall be backfilled to the level of the original ground surface as specified below.
   1) Around Pipe: Backfill material around non-bedded portion of pipe and manholes shall meet the pipe foundation stabilizer material specifications (Paragraph 7.2.5, Subparagraph 2a)
   2) Remainder of Backfill: The remainder of the backfill shall be the original excavated material consisting of clay, sand, gravel, soft shale or other material suitable to achieve proper compaction. The size and number of rocks or stones used in the backfill shall be such as not to interfere with proper compaction as determined by the Town Inspector. Backfill shall be placed in lifts of which the loose depth shall not exceed 18 inches.
   Original excavated material that is unacceptable for backfill shall be disposed of at the Contractor's expense and replaced with acceptable backfill material specified in Paragraph 7.2.5 Subparagraph 2c.
   3) No rocks or stones in excess of three (3) inches in diameter shall be included in the top one (1) foot of the trench. Where surfacing is to be placed over the trench, the six (6) inches shall be a select graded granular road base material as specified in Paragraph 3.2.3 Subparagraph 3 of this manual.
   4) Compact fill materials to following densities at optimum moisture content:

a) Structural Fill. Under and adjacent to all concrete foundations, to 95% maximum density.
b) Granular Fill. 90% maximum density.
c) Unclassified Fill. Areas to receive pavements: 90% maximum density except top four (4) feet which shall be 95% maximum density. Overlot areas: to 90% maximum density.
d) Maximum density shall be defined by the ASTM Specification D698,otherwise known as Standard Proctor. The moisture content of the backfill material shall be such that the contractor is able to meet the specification.

If, in the judgment of the Town Inspector, optimum moisture is not present in backfill material, wetting will be allowed. Jetting or inundation will not be permitted.

7.2.6 EXCAVATION IN EXISTING SURFACED STREETS: If for any reason whatsoever, any contractor, public or private utility, has to open up or otherwise perform any excavation in any street which is surfaced, the following requirements shall apply:

1. Notify the Town Clerk, Town of Lyons, at least forty-eight (48) hours in advance of the proposed work. Obtain a street cut permit. Only one side of a street may be closed at any one time.
2. Notify the public and/or private utility companies which could be involved.
3. The cutting of any existing bituminous or concrete surfaced street shall be accomplished by either wheel-cutting or saw-cutting only.
4. The replacement of the street pavement section shall comply with Paragraph 7.2.7.
5. Adequate barricades, signs, and warning devices shall be place and maintained during the progress of the work.

7.2.7 RESURFACING: Paving, cur, gutters, sidewalk, improved surfaces, or other street improvements removed, damaged or destroyed during construction shall be replaced to the same elevation and alignment, equal to and consistent with the undisturbed portions of the improvements existing prior to trench excavation. Subgrade for all restored surfaces shall be thoroughly compacted in accordance with Paragraph 7.2.5 Subparagraph 3h.

1. Materials:
   a. Aggregate Base Course: Aggregate base course shall conform to Paragraph 3.2.3 Subparagraph 3 of this manual.
   b. Bituminous Surfacing: Asphalt surfacing shall conform to Paragraph 3.2.3 Subparagraph 7.
2. Construction: Surface replacement shall be the placement of 6”-8” of concrete or 3” asphaltic concrete on six (6) inches of compacted base course, previously placed and compacted over a stabilized trench backfill subgrade. Method of installation shall conform with Section 3 of this manual.
   Where gravel surfaces are to be replaced, the Contractor, prior to trench excavation, shall salvage all existing gravel surfacing by windrowing or any other method he may elect, so as to prevent contamination of the surfacing material.
   Following compacting of the backfill to six (6) inches below natural grade and disposal of the surplus material from excavation, the Contractor shall top out the

trench with a six (6) inch compacted layer of base course material. The salvaged gravel surfacing shall then be replaced and the street restored to equal or better condition than existed prior to starting construction.

7.2.8 CONCRETE: Unless otherwise noted, all concrete referred to in these specifications shall have a minimum compressive strength of 3000 psi in 28 days. The concrete mix shall have a maximum slump of four (4) inches.

7.2.9 WORK PROGRESS AND STREET MAINTENANCE DURING CONSTRUCTION: The complete backfilling operation to the finished grade and cleanup operation shall be prosecuted on a continuous basis and shall follow within 50 feet of the installation of the pipe. However, at the end of each working day, pipe backfill shall be completed to within 20 feet of the installation of the pipe.

During construction, trench backfill in existing streets shall be topped out with not less than nine (9) inches of aggregate base course and maintained free of chuckholes, ruts and loose rock, until asphalt surfacing is in place. Resurfacing of the street shall be accomplished in accordance with Paragraph 7.2.7 within 14 days of backfilling.

During cold weather, when the asphalt plants are closed, the contractor shall install and maintain 1-1/2 inches of temporary cold bituminous surfacing in a rut-free, smooth riding condition. In the spring the contractor shall remove the temporary surfacing and install surfacing in accordance with Paragraph 7.2.7.

Immediately following installation of the temporary or permanent asphalt surfacing, the entire width of the asphalt surface and concrete gutter, if in place, shall be cleaned of all debris and maintained free of rock and debris throughout the construction period.

No separate payment will be made for installing and removing cold bituminous surfacing or base course, but will be considered a subsidiary obligation of the work.

7.3 TESTING

Compaction tests shall be the responsibility of the contractor and the test results supplied to the Town Inspector prior to final acceptance or use of the pipe line. The frequency of tests shall be as follows:

At least one compaction test for every 300 feet or less of pipe line installed. The depth and location at which the test is to be conducted shall be designated by the Town Inspector. This requirement can be relaxed at the discretion of the Inspector.

The compaction test shall be performed in the presence of the Town Inspector.

The tests will be conducted by a certified laboratory or signed by a professional engineer registered in the State of Colorado.

7.3 STANDARD DESIGN DRAWINGS

Figure 7-1 Underdrain Details

SECTION 8
INSPECTION, ACCEPTANCE AND GUARANTEE

8.1 INSPECTION

1. Inspections during the construction of all public improvements will be preformed by the Town Inspector.

2. The construction of the public improvements will generally follow consistent construction sequence or phasing. Each sequence or phase involved in the construction of the public improvements must be inspected, tested, and approved before proceeding to the next phase. Each phase may also require several inspections. The frequency and timing of inspections during each phase will be established by the Town Inspector after conferring with the contractor.

3. The construction of each public improvement shall generally be phased as follows:

CURB, GUTTER AND SIDEWALKS

A. Preparation and compaction of subgrade.
B. Placing and compaction of aggregate base course
C. Placing of concrete.
D. Final inspection and acceptance.

STREETS

A. Preparation and compaction of subgrade
B. Placing and compaction of aggregate base course.
C. Placing asphalt prime coat when required.
D. Placing and compaction of bituminous service course.
E. Placing seal coat when required
F. Final inspection and acceptance.

SIGNS

A. Final inspection and acceptance

WATER, SEWER, AND STORM DRAIN SYSTEMS

A. Trench, manhole and structure excavation
B. Installation of pipe, fittings, valves, thrust blocks, catch basins and all structures..
C. Backfill and compaction of trenches and around all structures.
D. Pressure testing of all water lines. All other testing of pipeline installation as required.
E. Final inspection and acceptance.

UNDERGROUND ELECTRIC DISTRIBUTION SYSTEMS

A. Excavation for conduit or conductor installation, junction box or any other electrical structure.
B. Installation of conduit or conductor, junction box, or any other electrical structure.
C. Backfill and compaction of all trenches and structures.
D. Testing of all required elements of the installation.
E. Final inspection and acceptance.

4. It will be the responsibility of the contractor to call inspections a minimum of 24 hours in advance of the inspection. Work done without proper inspection will be subject to rejection. All work found by inspection or testing to not meet the minimum requirement of this Public Improvement Manual shall be subject to removal and replacement.

8.2 ACCEPTANCE

The developer or contractor shall notify the Town Administrator when all public improvements have been completed and are ready for final inspection and acceptance. The Town Administrator will provide the final inspection and notification of acceptance of the public improvements. The date of acceptance will be the date of the acceptance letter to the developer. Items not meeting the standards outlined in this manual will not be accepted by the Town until all corrections have been made by the developer.

8.3 GUARANTEE

All public works improvements shall be guaranteed by the developer or contractor for a period of one year after acceptance of the completed work by the Town Administrator. The form of the guarantee shall be bond, letter of credit, or some other form of written guarantee acceptable to the Town of Lyons.